THE RHODESIA

Agricultural Journal.

Issued by Authority of
the Minister of Agriculture and Lands.

Vol. XXXVIII., No. 1.] JANUARY, 1941. [5s. per annum

LEADING FEATURES.

A NEW DITCHER DESCRIPTION OF THE IMPLEMENT

WHEAT VARIETIES AVAILABLE FOR DISTRIBUTION

VETERINARY NOTES WIRE IN THE HEART

OVERPRODUCTION AND SCIENTIFIC IMPROVEMENTS IN AGRICULTURE

THE FARM HOUSE JAM MAKING

THE MANUFACTURE OF CHEDDAR CHEESE

RHODESIAN MILK RECORDS.

SALISBURY.

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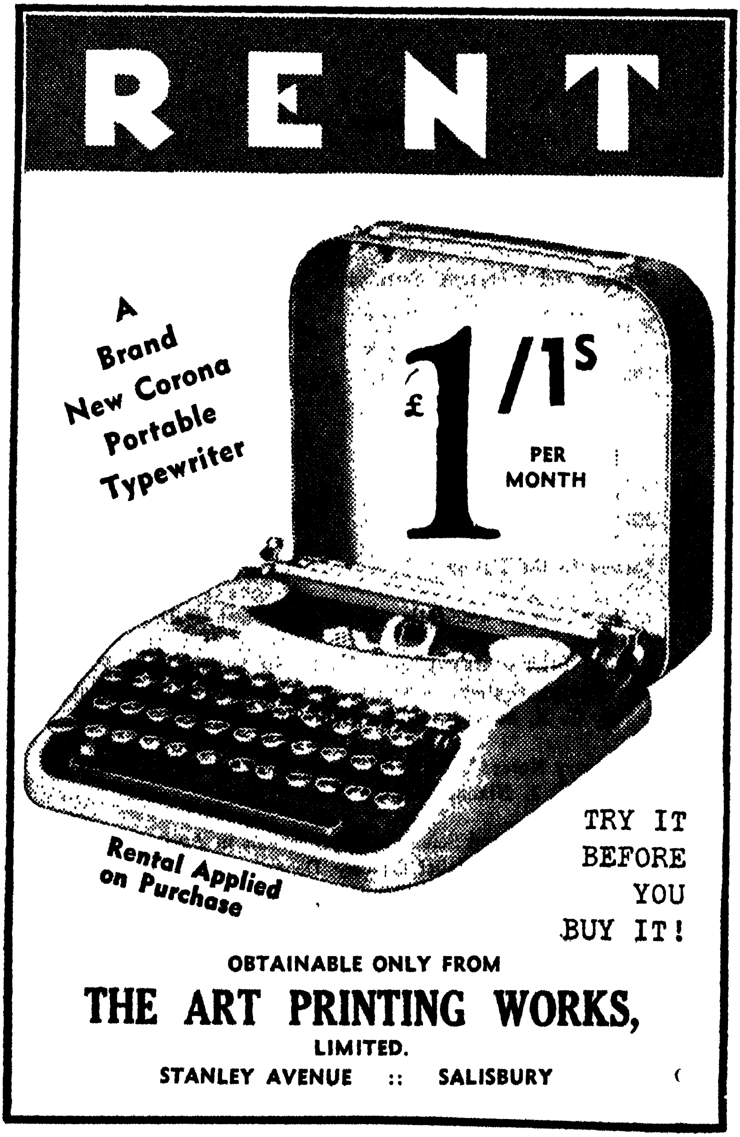
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INVESTIGATION ON BILHARZIA

LIST OF BILHARZIA-FREE BATHING PLACES.

The localities listed below have been examined and found to be free from bilharzial snails.

CLASS I.

Bathing places where there is reason to believe will remain free from bilharzia indefinitely, provided that there is no change in local conditions such as might be brought about by the accumulation of picnic rubbish, the dumping of refuse, or exceptional drought.

(1) Inyanga. Branches of the Inyongombie River near the main road bridges.
(2) Inyanga. Pungwe River above the Pungwe Falls.
(3) Umtali, Nyachowa Falls.
(4) Umtali, Odzani River above the Odzani Falls. Also the pool immediately below the Odzani Falls.
(5) Marandellas, pools on the Wagon Road drift on the road leading through Longlands Farm, 3½ miles North of Marandellas.
(6) Fort Victoria. Chippopopo Pools near Zimbabwe.

CLASS II.

A bathing place which is free from bilharzial snails at the present time and is expected to remain so provided that the pool is given treatment once every six months.

(1) Darwendale. Bathing pool near Chrome Mines. This pool is on private property and its use is confined to the local residents.

CLASS III.

Bathing places which are bilharzia-free at the present time and which will remain so for a period of at least two months.

(1) Salisbury, Mermaids' Pool.
(2) Bulawayo, Diana's Pool.
(3) Bulawayo, Matopos Dam. The shores of this dam between the sailing club and the mouth of the drainage canal, in particular, are known to be safe.
(4) Que Que. Sebakwe Poorte. Bathing in ponded area above the weir near the Sebakwe Poorte is not recommended.
(5) Sinoia. Sinoia Caves.
(6) Sinoia. Hunyani River, between the Salisbury-Sinoia road bridge and the falls a quarter of a mile above it.
(7) Bromley. Hunyani River for one quarter mile above the bridge on the South Marandellas Road, four miles south of Bromley.
(8) Marandellas. Falls on a branch of the Wenimbi River four miles from the Ruzawi School.

Owing to weather conditions the Nyaderi River near Bindura, which was included in the last list of safe bathing places has not been re-examined.

A further list of bilharzia-free bathing places will be published shortly before Easter.

ANDREW PATON MARTIN. M.B., Ch.B., D.P.H.,
Medical Director.

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MAY, 1941.

NOTICE.

FERTILISER SUPPLIES.

IN order that the supply position regarding Tobacco and other Fertilisers for the season 1941 42 may be assessed, all farmers, as well as tobacco growers, are requested to place their orders with their respective Fertiliser Firms before the 31st May, 1941.

Failure to comply with this request may result in supplies indented for after the 31st May, 1941, not being forthcoming should there be any shortage of fertiliser during the 1941-42 season.

As soon as the supply position has been assessed sales in accordance with the available fertiliser supplies will be authorised and farmers are particularly requested to take delivery as early as possible. By their so doing storage space will become available and will permit the Fertiliser Firms to take every opportunity of replenishing their stocks.

H. C. MALONE, Secretary,
Office of the Controller of Supplies.

Frankel House,
P.O. Box 1281, Salisbury.

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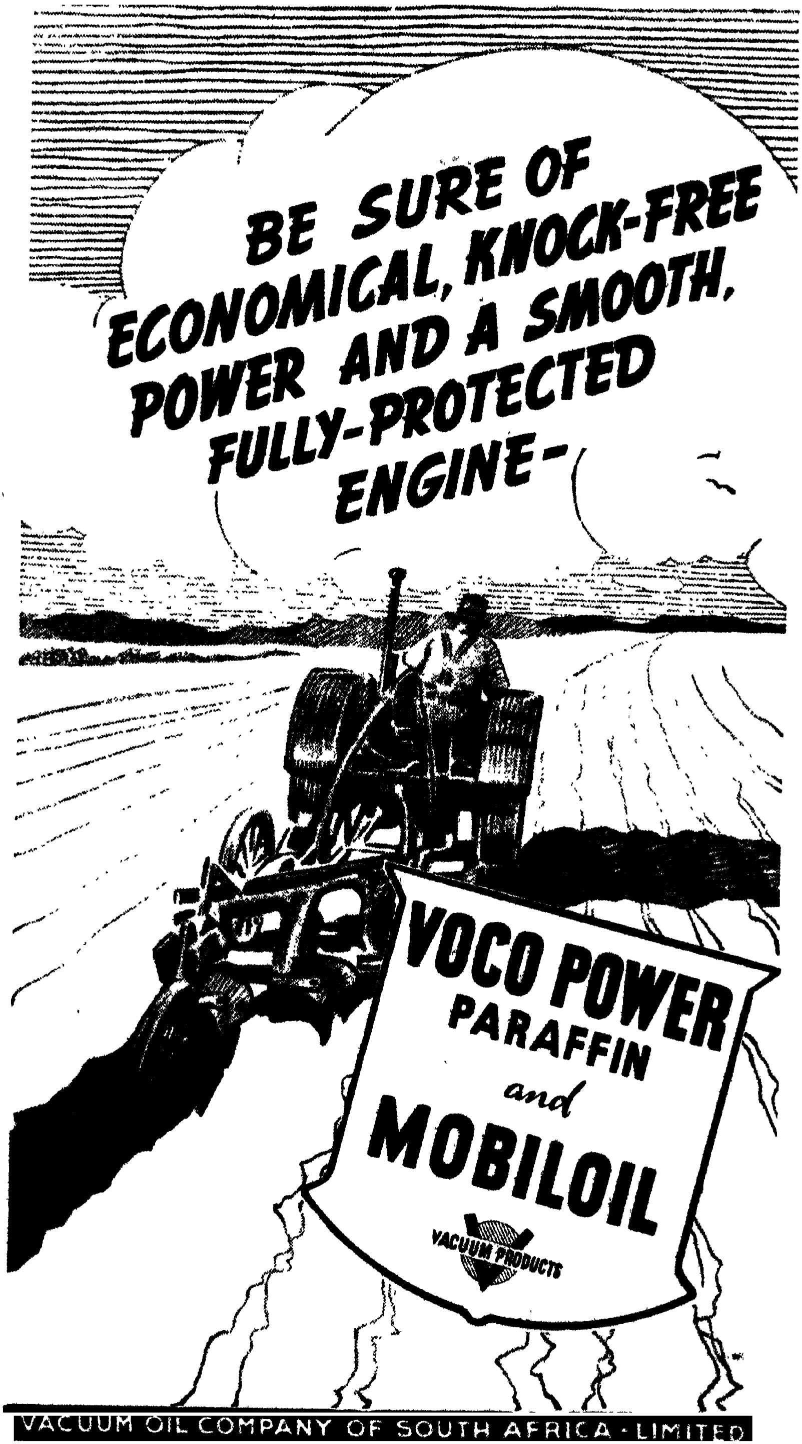
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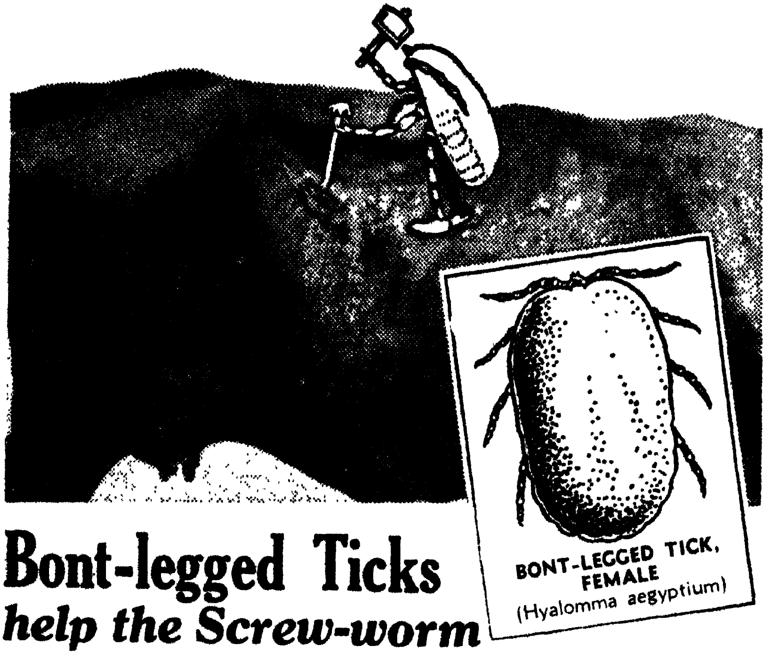

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UNLIKE the Bont Tick, the Bont-legged tick does not transmit heartwater, but the bites of these parasites are a menace to cattle. Bont-legged ticks multiply tremendously, the female being capable of laying up to 15,000 eggs. Apart from other ill-effects, these bloodsuckers feed in clusters and cause punctures in which the female Screw-Worm Fly deposits her eggs. The damage done by the resulting screw-worms is well known.

Regular dipping in "K" Cattle Dip will ensure that the animals are kept tick-free and so much less likely to be attacked by the Screw-Worm Fly. "K" Cattle Dip is particularly suited for use on Bont and Bont-legged Ticks. Because of its exceptional penetrating properties, the dip is able to reach down to the mouthparts of these ticks, which go deeply into the animal's hide.

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THE RHODESIA
Agricultural Journal

Vol. XXXVIII.] No. 1 [January, 1941

New Year Message to the Farmers of Southern Rhodesia

FROM THE SECRETARY, DEPARTMENT OF AGRICULTURE AND LANDS.

In the absence of the Minister of Agriculture and Lands on a very important mission to India and Australia, which it is hoped will prove of considerable assistance to our two primary industries, I have been asked to send through the *Agricultural Journal* a New Year message to the farmers of the Colony. In doing so I wish I might be penning these lines at a time when the seasonal outlook was more encouraging. To date there has been an heart-breaking absence of the usual planting rains which has struck particularly hardly at maize and tobacco growers and dairy farmers. I pray that general rains may fall within the next week or so and that with a good distribution for the remainder of the season the ultimate returns to all classes of farmers may still not be far below the normal.

Crop growth is seldom as vigorous and rapid after the middle of January as it is during the previous two months, but frequent stirring and aeration of the soil, between showers, does much to counteract the ill-effects of late planting. Where the lateness of the rains will seriously curtail the acreage which can be planted to main crops, no effort should be spared to get in catch crops for sale, renovation of the soil, winter feed for stock or conversion into compost. The winter season, if the rainfall is scanty, will be a hard one for livestock. Let us make the utmost use of the natural

veld for conversion into hay and allow no crops that can be conserved for any useful purpose to be used uneconomically.

Keep your heads high! Those who refuse to acknowledge defeat are undefeatable. This is the lesson taught us by our forces in the Battle of the Dunes, in the glorious evacuation of the Dunkirk beaches and by our relatives, friends and fellow-countrymen in the British Isles, suffering all the horrors and strain of Nazi bombing. Don't allow the season to "get you down," battle on, remembering that God helps those who help themselves.

One and all, we in the Division of Agriculture and Lands, send you our best wishes for 1941.

H. G. MUNDY.

23rd December, 1940.

Editorial

Notes and Comments

Conservation of Local Fertilisers.

William B. Strain, writing in *Nature*, draws attention to the terrific waste of fertiliser material that has been going on in the British Isles for many years. With the restrictions of fertiliser imports and of shipping space, and the enormous increase in agriculture generally, every available source of fertiliser material will have to be used. The amount of squandering of natural resources during the last twenty years in Britain has been nothing short of sinful. City and town and country have been allowed to dissipate organic matter and chemical elements amounting to millions of tons per annum. Manures or fertilisers are available in waste materials in Britain to the extent of hundreds of thousands of tons.

Everything of value should be utilised, and the writer has suggested the following sources:—

(1) Seaweed. (2) Leaves from trees. (3) Garden refuse: (*a*) hard which can be burned and used as ash, and (*b*) soft which can be composted. (4) Damaged fruit. (5) Fish and slaughter house wastes. (6) Night soil or sewage. (7) Existing refuse dumps. (8) Screened dust which consists of fine screenings of household refuse, and is comprised almost entirely of fine ash which is only partly burned.

This screened dust has been found in Scotland to be exceedingly valuable as a fertiliser and has been used for many years for opening up heavy clay soils. In addition, screened dust supplies all the known important minor elements in considerable quantity, and the others in smaller amounts.

Organic and Inorganic Fertilisers.

The famous Broadbalk wheat field at Rothamsted Experimental Station is approaching its centenary. This year it was harvested for the ninety-seventh year in succession. Much information has come from this unprecedented period of experimentation, and some of it may seem surprising.

Comparison between the farmyard manure and the artificial fertiliser plots has shown that for the conditions existing there (1) average yields are approximately the same; (2) seasonal fluctuations in yield are smaller on the farmyard manure plot; (3) deterioration of yield with time is slightly lower on the farmyard manure plot; (4) no significant difference between plots has been detected as regards either baking quality or the nutrient value of the grain; (5) there is no evidence of any special infestations by diseases or pests on the artificially fertilised as compared with the manured plot.

One of the most striking features of the Broadbalk results is the predominant effect of artificial nitrogenous fertilisers on yield. Nitrate of soda and sulphate of ammonia have been about equally effective, but unit for unit of nitrogen, farmyard manure has been only half as effective as the inorganic fertilisers, including both immediate and residual responses.

Although these results would seem to disprove many of the conclusions arrived at in India and Africa, it should be

remembered, what is so often forgotten, that climate plays a dominant part. It was pointed out in an Editorial Comment of a previous Journal that the rate of decomposition of organic matter in a temperate climate is enormously less than in a tropical zone. The amount of organic matter remaining in the soil as root and stubble is in England sufficient to maintain the carbon-nitrogen ratio and the vitality of the soil bacteria. In tropical and semi-tropical countries it is not. Organic matter must be added, or the soil must be left under grass for a year or two.

Some—including Sir Albert Howard—would do away with artificial fertilisers altogether, though it is difficult to know how they intend to replace the large amounts of calcium, potassium and phosphorus and other elements removed every year by the crop. The sane and sensible view would seem to be, as always, the moderate one—that is that under modern methods of farming both organic and artificial fertilisers are necessary for profitable farming and for the permanent maintenance of soil fertility.

Minor Elements.

Until fairly recent years analysis of plants, and particularly of plant ash, yielded the conclusion that certain elements were essential for the growth of all plants. These elements were carbon, nitrogen, oxygen, hydrogen, potassium, phosphorus, calcium, iron, magnesium and sulphur. Other elements such as silicon, sodium, chlorine and many others were almost always present, but were not regarded as essential for the growth of all plants. Experiments to prove these contentions were carried out in water and sand cultures and did seem to prove what they set out to prove. However, doubts have arisen and many of these earlier experiments are discredited, particularly as they did not take account of "minor" elements. The so-called minor elements are not really minor at all: they have been found to be as essential for plant growth as nitrogen and phosphorus, but they occur in soils and in plant ash in such exceedingly small quantities that the expression "minor" has become associated with them. The minor elements which are now generally regarded as essential to plants are boron, copper, zinc, manganese and

molybdenum and there are possibly many others. For instance, recently in New Zealand considerable stress has been laid on cobalt. The reason why these elements were not found to be important before is that a mere trace is sufficient, and that the chemicals, water and utensils used in the early experiments were probably contaminated.

The minor element which first attracted attention was boron, a deficiency of which led to definite symptoms resembling disease symptoms. A deficiency of boron was found by Dr. Morris to be responsible for gumminess in citrus fruit at the Mazoe Citrus Estate, and the effect of the application of a small quantity of boron was dramatic. A deficiency of zinc can cause nutritional disorders of fruit trees, as can a deficiency of copper.

These minor elements are thought to be largely responsible for enzyme action in the plant, particularly in such processes as carbohydrate oxidation, respiration and nitrate reduction. Manganese and copper are particularly important in this respect.

Considerable work remains to be done on the role and function of minor elements in the soil and in the plant. Generally they exist in sufficient quantity, but may become depleted. Their concentration should not be too high, as in some cases even a small increase over the quantity required by the plant may cause definite and severe injury.

The Dairy Industry.

The Economic and Statistical Bulletin of the 7th December is devoted largely to an analysis of the past ten years of dairying in Southern Rhodesia. During that time there has been a steady expansion, but over the same period the value of field crops and livestock products has risen still faster with the result that the relative importance of dairy production in the Colony fell. In the first five years of the period 1930-39 the estimated gross value of dairy production to the European farming community averaged £197,000 as compared with an average output valued at £207,000 during the last five years of the period.

There has been a general downward trend in the number of European-owned cattle, the number in 1937 being less than at any time since 1920. Since then there has been a considerable decrease in losses of cattle from disease and poverty, so that in 1939 the number of cattle was 21,000 greater than in 1937. The number of dairy cows has remained more or less constant; the effect of the decline in numbers is apparent in the figures of non-dairy cows. The combined figure of pure-bred and grade cows increased from 33 per cent. of the total number of dairy cows in 1933 to 44½ per cent. in 1937 and 1938. Owing to the inclusion with grade cattle of certain mixed grades in 1939 no comparative figure is available for that year.

The total milk production from European-owned cows fluctuated somewhat. It was lowest in 1934 and 1938 at 5,400,000 gallons and highest in 1936 at 6,500,000 gallons. In 1939 the production was 5,700,000 gallons.

The average annual production was about 115 gallons per dairy cow. This figure contrasts sharply with the yield in England and Wales, which at the census of 1930-31 was 462 gallons.

With regard to the utilisation of milk, apart from the tendency to increase with the growth of population, the amount of milk sold for liquid consumption remained fairly stable. For the five years 1935-39 it was about 25 per cent. of the total milk supplies. During that period the percentage used for the production of butter showed a slight upward trend, while that for cheese production remained fairly constant.

The average *per capita* consumption of liquid milk is in excess of ½ pint per day.

Letters to the Editor

The Editor, *The Rhodesia Agricultural Journal.*

Dear Sir,—We hope the following may be of interest to your readers and those interested in the laying down of Rhodes grass pasture.

Ten acres of good type sandveld, which had previously grown tobacco and maize, was ploughed during the first week of January, 1940. The land was twice disc-harrowed in order to kill any weeds not turned under; a crop of Somerset velvet beans was then broadcast at the rate of 50 lbs. to the acre. Immediately following this Rhodes grass, mixed with sifted wood ash, was broadcast with the use of a fertilising machine. A brush harrow was then dragged over the surface to cover the seed. The bean crop grew well and was cut for hay in the early part of May. The Rhodes grass was then visible; it appeared to increase after the removal of the bean crop and remained green throughout the winter. After an inch or two of rain during October and November, it has come away very well and promises to be the best stand of grass we have yet obtained.—We are, etc.,

R. AND I. FAED.

Ziroto, Trelawney,

30th November, 1940.

A New Ditcher

By D. AYLEN.

DESCRIPTION OF THE IMPLEMENT.

A simple but most effective modification to the grader blade of ditchers was recently tested on a trial model and the following article is a brief account of the machine and the results obtained.

Referring to the illustrations it will be seen that the grader arm has a "universal joint" in the middle which permits the setting of the two sections of the blade at different horizontal angles (Fig. No. 1) and also allows considerable vertical adjustments of the outer half (Fig. No. 2). Thus both sections may be run at angles which give the greatest efficiency. Varying combinations of adjustments can be made to best suit any required operation. For example, the front half may be run level to form a wide channel whilst the outer half is cocked up to elevate earth to form the bank.

It should be noted that the illustrations are of the first trial model, and that for rapid adjustment slightly different but simple methods of locking the movable parts are required. An error of assembly which some may note is that the tail plates have been bolted on the wrong side of the landslide.

The lengths of both arm and landslide are greater than usual. This does not make for heavier draft, provided unduly heavy plate is not used in the construction of the implement, whilst the lesser angle at which it is possible to work the arm allows the soil to slide more freely. The longer than usual landslide holds the ditcher in the furrow with greater certainty.

The ditcher was primarily designed to construct contour ridges with wide banks and wide shallow water channels without recourse to subsequent trimming. It satisfactorily performed this task with greater efficiency than was hitherto possible.

During the test several advantages came to light as well as peculiarities of which considerable advantage may be taken. These will be described at the end of the article.

METHOD OF CONDUCTING THE TRIAL.

During the trial the ditcher was loaded to full capacity but it was prevented from cutting unloosened soil.

Naturally an endeavour was made to make as large a ridge as possible, but at any stage no round of the ditcher was made if it was not clear that it would effectively grade up a large amount of soil. Those who are familiar with ditchers will know only too well that in order to build a big ridge the ordinary ditcher must often go round without appreciably increasing the size. This was not done at the trial; instead further soil was first loosened with the plough before the ditcher was entered again.

It can therefore be considered that the ridge was built with a greater degree of efficiency than is usual and that this size of ridge may be readily attained without difficulty and could even be improved on provided further, but less efficient rounds, were undertaken at the end of each stage.

Without previous experience of the capabilities of the machine a definite attempt was made at the trial to construct a contour ridge of the type which has a wide bank and wide channel with gentle side slopes. This shape has proved for all but unusual conditions the most satisfactory for several reasons.

(*a*) It is initially safer.

(*b*) It is permanently stable.

(*c*) Maintenance of a broad ridge can be carried out entirely by the plough and entails few, if any, extra rounds if plough furrows are struck out as described at the end of the Soil and Water Conservation Bulletin Part II.

(*d*) When the ridge is new the planter may be run along the top of the bank and planting continued until the lowest rows meet the channel.

(*e*) If maintenance is carried out as described above the ridge after a few years assumes a shape which may be crossed by most farm implements and worked along by all types.

(*f*) It has been repeatedly noted in this country that rats rarely infest wide banks which are clean cultivated.

(*g*) The wide channel permits of better drainage during long wet spells.

Fig. No. 4 gives an idea as to how far this object was attained. The ridge which has been constructed entirely by plough and ditcher has the desired shape and size.

DESCRIPTION OF THE TRIAL.

The soil on the farm on which the test was made is red loam of average hardness, but a land was chosen which had been in disuse for a number of years owing to sheet erosion and had subsequently been puddled by cattle during summer.

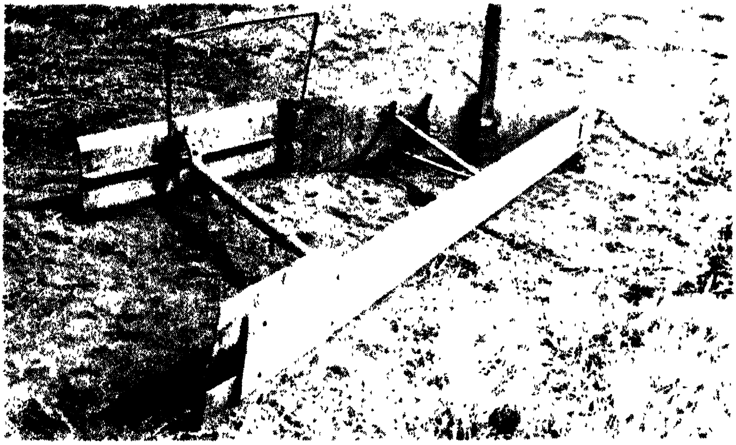
The land at that time—September—was above average in hardness. The hardness was, however, largely offset by the fact that the ploughing was supervised by a farmer who was thoroughly conversant with the plough.

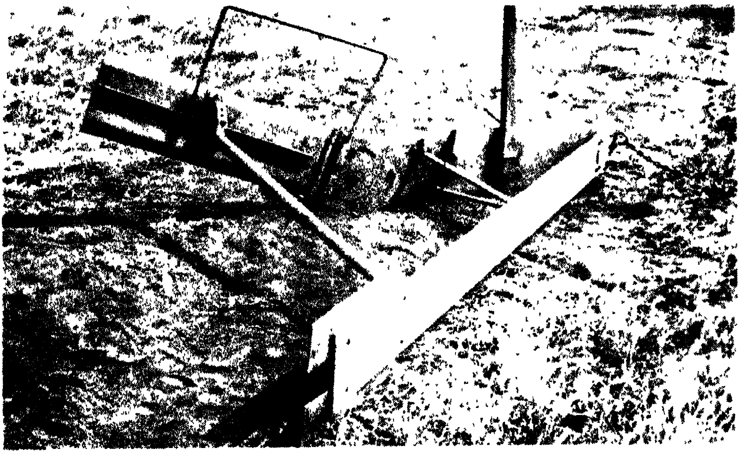
An iron-wheeled tractor rated at 25/17 horse power was used with a heavy three furrow disc plough, and also to pull the ditcher.

As is the usual practice a strip of about 10 feet wide was first ploughed up throwing towards the centre (*ie.*, a gathering furrow). Unfortunately owing to the hardness of the soil the penetration of the back disc on the second round was only about six inches.

The ditcher was then entered with the front part of the blade at about 30° and the outer part opened at a lesser angle and cocked up. Owing to the shallow ploughing it was not possible to load the ditcher to capacity and three rounds were needed to push the loosened soil into a high narrow bank at the centre with almost flat and clean furrows either side.

The plough was now used to provide more soil. It was set to plough maximum depth, but only allowed to take





Figs. 1 and 2.—The new Ditcher.

Fig. 3.—Water channel of a contour ridge made by the ditcher

Fig 4.—A contour ridge made by the new ditcher

half a cut with the middle disc whilst the front disc ran idle, the rear disc of course took a full cut. This furrow was about 8 inches deep.

Two rounds of the ditcher, which was adjusted as shown in Fig No. 2, for this and all subsequent rounds, were sufficient to grade up all the loose soil.

The cycle of plough and ditcher was repeated once more as last described. As the bank was then high enough work was modified so as to develop the water channel. The plough worked on both sides taking a half width but deep cut on the upper side but doing normal ploughing on the lower one. All grading from now on was done entirely on the upper side. A forward and return trip of the ditcher was enough to grade up the soil, this procedure was repeated once; by that time the bank had sufficient width.

An extra trip of the ditcher was made to completely clean out the water channel. The depth attained by the plough had gradually increased with each round until it had reached 10 inches, the ditcher increased this to 11 inches on these last rounds, and the channel now was level across the bed which was 4 feet wide.

The ditcher was not used again but the plough was used so as to plough the soil away from the upper side of the water channel, and also to close the depression below the ridge left by removal of soil to form the bank. This was done as two separate stages.

The first operation was carried out by striking out a "gathering" furrow at an even distance of about 3 yards from the top edge of the channel and continuing rounds of the plough until the channel had been reached.

The second operation, *i.e.*, complete filling of the depression below the bank, was not required to improve the stability of the bank but was undertaken in order that the ridge would present as small an obstacle as possible to the passage of implements. It was accomplished by a few trips of the plough which on its return journey did normal ploughing of the land elsewhere.

A much longer than usual hitch chain was used between the tractor and ditcher. The ditcher tracked so well that the great length of chain (18 feet) proved an advantage.

RESULTS AND COSTS.

The number of rounds amounted to 9 with the ditcher and 13 with the plough, 22 in all, but if the cost of construction is to be estimated one must subtract the width of the strip which had been worked on and left ploughed. This equalled in width 10 rounds of the plough so the actual extra work equals twelve rounds of construction. But another way, a mile of ridge made this way before ploughing a land would take as much effort as that required to plough 8 acres. Additional costs must then be added for extra labour (an extra 2 or 3 natives) and delays when changing from one implement to the other.

From this one could safely estimate that for tractor farmers the cost of contour ridging a land is about half that of ploughing it.

Looking closely at Fig. No. 3 the four different stages of ditcher can be seen as ridges on the bank. These will disappear naturally. The water channel is smooth and clean and the slope up from the channel to the land is very gentle. It is estimated that when the bank has settled the water channel will have a cross sectional area of approximately 20 square feet. The crest of the bank will, when settled, be about two feet above the channel.

It will be noted that in Fig. No. 4 it is difficult to detect just where the down slope of the bank merges into the land. This is actually the case and makes for easier cultivation than an abrupt change of slope.

CONCLUSIONS.

1. More efficient grading up of the soil is possible with the jointed grader arm, as the adjustments permit of the blade being set so that in one movement the soil is dumped where required.

2. Running the front portion of the grader arm flat has numerous advantages, mainly due to the fact that a deep "V" ditch is not required, *viz.*:—

(*a*) Ploughing by the ditcher is obviated.

(*b*) The shallower cut reduces the vertical lift of the soil. It therefore slides better at the same angle of opening. To make a ridge of similar capacity with a straight blade type requires a lift of 3 feet as against 2 feet.

(*c*) The clean wide channel made at each stage gives ample space over all of which the two inside wheels of the tractor can get a good grip.

(*d*) The shallower cut means a tractor can run with two wheels in the furrow leaning over at a lesser angle, and also depth of cut is not restricted by the edge of the land fouling the sump or differential.

(*e*) The land slide runs with its face vertical and therefore does not tend to climb out of the furrow.

3. The long landslide and jointed arm facilitate keeping the ditcher in the furrow on its first few rounds. Later the ditcher holds the furrow so well that it does not require to be kept there by manoeuvring the tractor and using a short hitch. On the trials the tractor was run as if ploughing.

This type of ditcher thus overcomes many of the difficulties encountered when using a wheeled tractor and is well suited to that form of draft.

There is no reason why a model of the same size but with a lighter grader arm should not prove satisfactory with oxen, provided it is used judiciously and lightly loaded. To make the same sized ridge might require two or three extra rounds.

ADVANTAGES OF A FLAT CUT OVER A "V" CUT.

When using this new ditcher the early rounds of both the plough and the ditcher must be undertaken with just as much skill and care as hitherto, but it has the advantage that the later rounds do not become increasingly difficult.

In nearly every case where farmers have made contour ridges with ditchers the ridges fall far below the recommended sizes for one or more of the following reasons:—

(*a*) Lack of skill in using a plough.

(*b*) Insufficient number of rounds with the ditcher at each stage.

(*c*) Omission of the final stages of the plough and ditcher.

(*d*) Failure to clean out the channel by shovels and use this soil to top up the bank.

The new ditcher will not overcome bad ploughing, but the fact that the deepest cut required at the final stage is under a foot as against 18 inches for ordinary models, does make for greater ease of ploughing during the last stage.

One is apt to discontinue work at any stage and proceed to the next one if marked visable results are not being attained. There is less likelihood of skimping the work when all work produces clearly discernable increase in height or width. It is considered that the use of this ditcher would create a tendency not to omit the final stages of construction.

With the ordinary type of ditcher a certain amount of negative work must be done. To construct a ridge so that the top of the bank is two feet above the bed of the water channel a bank with a crest 18 inches above ground level must be made. This necessitates cutting a "V" ditch 18 inches deep which is afterwards smoothed by ploughing and shovels to form a wider channel 6 inches deep.

The new ditcher requires a cut with a maximum depth of about one foot and a bank just over one foot in height so that a water channel of the same depth and possibly more easy side slopes may be formed.

Whereas in the first case the "V" ditch is closed by ploughing soil into it, in the second case the channel which already is four feet wide is increased in capacity by using the plough to throw the soil in the strip immediately above, *upwards and away* from the channel. One can see from the illustration that the down slope from the land into the channel has a width of nine feet and is therefore gentle.

This feature is perhaps the greatest advantage of the new ditcher, as it avoids the necessity of doing two quite tricky operations (*i.e.*, forming and closing the deep "V" ditch) which to some extent are not "useful work."

Wheat

Brief characteristics of varieties tested at the Plant Breeding Station, Salisbury, and available for distribution.

By T. K. Sansom, B.Sc., Plant Breeder.

The following selected pure lines of wheats grown at the Plant Breeding Station, Salisbury, are available for free distribution to farmers.

The seed supplied should be used for bulking up for sowing on a larger scale.

Applicants are requested to apply early, stating what varieties are required. Not more than four varieties can be supplied to each applicant and the amount of seed of each variety will depend on the number of applications received for each variety.

No applications can be considered which are received after the 28th February, 1941.

1. Reward B-21-22. S.1.
2. Reward B. 23-25. S.1.
3. Granadero Klein.
4. 122. D.1.T.L.
5. 131. C.5.P.
6. Jubilee.
7. Kenya Governor.
8. Pioneer.
9. Sabanero.
10. Kruger.
11. Pusa 4.
12. Beltista.
13. B.256.b.1.A.64 (L).
14. N.B. 230. A.14 (L).
15. Pilgrim.
16. Punjab 8A.

The two *Reward* strains have been grown on a fairly extensive scale during the past few years, they are beardless,

rust resistant, early maturing, have a very strong straw and are excellent milling wheats, but require a soil in good heart to yield well.

Granadero Klein.—Is a bearded wheat which is very resistant to rust and can be recommended for those areas where Karachi, Punjab 8A or Lalkassar Wali become badly rusted; it is fairly tall growing and late maturing, taking about a week longer to mature than does Karachi.

122D.1.T.L.—Is a beardless wheat resistant to rust and fairly late maturing; straw strong. Has done well in variety trials on vlei ground at Umvuma.

131.C.5.P.—Is a bearded wheat; it is probably the most rust resistant wheat grown in the Colony at present; late maturing.

Jubilee.—Is a cross made on the Plant Breeding Station between Reward and Wit Klein Koren and was previously known as Reward x Wit Klein Koren C.T.I. It is a bearded wheat with a very dense ear and exceptionally strong black awns; it is fairly rust resistant and matures a few days earlier than do Karachi, Punjab 8A and Lalkassar Wali. The grain is of excellent quality. This wheat was distributed for the first time last year and has shown great promise. Straw strong.

Kenya Governor.—Known also as "Somers Koren" and "90 day Wheat"; has been grown on a large scale in every district of the Colony for a good many years; in the last year or two it has lost a good deal of its popularity. It is fairly rust resistant and is early maturing. The straw is fairly weak and it appears to be more susceptible to frost than other varieties. A heavier rate of seeding is required for this wheat owing to its poor tillering habit and fairly large size of grain.

Pioneer.—Is a cross made on the Plant Breeding Station between Reward and Wit Klein Koren and was previously known as Reward x Wit Klein Koren C.T.2. It is a little taller growing than Jubilee; appears to tiller a little better but it is doubtful if it will yield as well as Jubilee; it is fairly rust resistant. Matures about three days later than Jubilee. Straw strong.

Sabanero.—Is a bearded wheat. Resistant to rust; fairly late maturing and tall growing. This wheat appears to be

better suited to vlei land than to irrigated lands. On rich irrigated land it is inclined to lodge badly. Has done well in variety trials on vlei ground at Umvuma.

Kruger.—Is a bearded wheat with extremely strong glumes. Is rust resistant; the straw is fairly weak and it will lodge fairly badly when well grown. Very early maturing.

Pusa 4.—Has been grown for a good many years in this Colony. It is beardless, fairly susceptible to rust, but in those areas where the incidence of rust attack is not severe will yield well. It is probably the most early maturing of any wheat grown in the Colony; it makes little leaf growth and should be of use to those farmers who thresh by means of hand power.

Beltista.—Is a bearded wheat, fairly early maturing and resistant to rust; it is inclined to shatter if left too late in the field. Has shown promise at the Plant Breeding Station and elsewhere.

B.256.*b*.1.*A*.64(*L*).—Is a beardless wheat resistant to rust and fairly early maturing. This wheat has shown promise at the Plant Breeding Station and elsewhere.

N.B.230 *A*.14(*L*).—Is a beardless wheat, resistant to rust and fairly early maturing. This wheat has shown promise at the Plant Breeding Station and elsewhere.

Pilgrim.—Is a bearded wheat fairly resistant to rust. Has shown fair promise at the Plant Breeding Station. Shatters more than do most bearded wheats.

Punjab 8*A*.—Is a bearded wheat; the growth habits are similar in all respects to Karachi which it has largely replaced. The seed, however, grown under the same conditions as Karachi is always larger and has a more metallic appearance. Under favourable conditions it is most probably the highest yielding wheat grown in the Colony. It is susceptible to rust, however, and in those areas where rust attack is severe, should not be grown, as a crop failure may result.

The following wheats are also available from the variety trials at Umvuma:—

1. 58.F.L.I. 2. Renown. 3. Florence.

Applications should be addressed to the Agriculturist, Department of Agriculture, P.O. Box 387, Salisbury.

Veterinary Notes

WIRE IN THE HEART (*Traumatic pericarditis*).

By W. J. Nixon, M.R.C.V.S.

I must first of all explain my choice of a name for a condition which, while known to the average stock farmer, has no common name in veterinary literature. I have included the word "wire" in the title, since this is the usual object found, on *post mortem*, to have caused the condition.

Most stockowners have, at one time or another, been puzzled to account for the illness of a single cow or bullock. Symptoms point to a digestive disturbance, yet the usual remedies bring no response. The beast may recover or, after a variable time, die in spite of all efforts.

Post-mortem Appearances.—For the sake of convenience a description of the condition found on *post-mostem* examination is given before proceeding further. This is as follows:— On opening the chest cavity it may be found that the heart sac (*pericardium*) is distended with pus. This is often accompanied by inflammation of the lungs.

On careful examination of a typical case of this condition, it may be found ,that when removing the large stomach, or paunch, the knife grates on some obstruction.

An area of inflammation, in the form of a channel, will be found to follow the course taken by the foreign body in its passage from the stomach, through the diaphragm (the sheet-like muscle dividing the abdominal cavity from the chest cavity) to the pericardium or heart sac. Along the course of this channel will be found the foreign body, which is often a small length of wire, a nail or other similar object.

To understand fully how such a foreign body may cause death it must be appreciated that anatomically about one inch only separates the base of the heart from the second stomach.

The heart is enclosed in the heart-sac, which is attached to the breast bone. Behind this lies the diaphgram, which is in close proximity to the second stomach.

A piece of baling wire or a six inch nail is swallowed by the animal, passes down the gullet, and often lodges in the

second stomach. The digestive action of the stomach forces the contents in a forward direction; this eventually leads to perforation of the stomach wall and diaphragm. Further pressure by the diaphragm assists penetration to the heart sac.

As the foreign body travels forward, inflammation follows its course.

When the heart sac is pierced an abcess with abundant formation of pus is the result. This eventually obstructs the action of the heart, and causes the death of the animal.

Symptoms during Life.—These are in many ways characteristic. The subject, usually a full-grown animal, shows signs of intermittent pain, manifested by restlessness and grinding of the teeth.

There is a tendency to remain for long periods in the standing position; the animal groans if forced to move about. As a result of the pain caused by the foreign body, the breathing becomes shallow and hurried.

When the heart sac becomes involved the respiratory symptoms are accentuated, the surface of the body and the extremeties become cold. If the animal be forced to move about the breathing becomes very difficult, with intermittent coughing. The animal shows an anxious expression, and stands with the front legs extended in front. There is rapid loss of condition, and death invariably follows.

The above are the train of symptoms observed in the majority of cases.

In rare instances the object may become lodged in certain parts of the digestive tract, producing intermittent attacks of indigestion evidenced by restlessness and signs of pain. In such cases the animals may maintain a fair condition and live many years.

Treatment.—It will be evident that medicinal treatment is of no avail.

Prevention is the best policy to adopt. Stockowners should make it a rigid rule that no pieces of wire, nails, sacking needles or similar objects are left in places to which cattle have access.

Cattle, especially milch cows, are known to swallow foreign bodies of every description.

Overproduction and Scientific Improvement in Agriculture

By A. L. Jolly, Relief Officer, Department of Economics, Imperial College of Tropical Agriculture.

It is proposed in this note to discuss an apparent paradox in agricultural economics: when agriculturists complain of general overproduction of a commodity, scientists and economists apparently direct their energies to *increasing* its production! An understanding of this apparent discrepancy is of considerable practical importance to the agricultural industry; if the farmer does not understand why the scientist strives for increased production, or if the scientist does not understand why the farmer complains of overproduction, no co-operative effort between them can be expected.

When the paradox is analysed it is found that neither of the two sides are stated in precise terms; the slight misstatement on both sides results in an apparent absurdity on the whole. The farmer, when he talks of overproduction, means something different, while the scientist does not direct his efforts precisely to increasing production. Let us consider the farmer's point of view first.

The farmer's statement that a commodity is overproduced or underconsumed (which means precisely the same thing), when taken literally, signifies that production is on such a scale that part is not consumed. But the fact that some of the production is unconsumed is not, in itself, a problem to the farmer. His problem is to obtain the maximum profit from the commodities he produces; it does not matter to him if he sells only half his produce provided that that half yields a higher total profit than any other volume of sales. Indeed, there have been cases where farmers have actually created a conditon of overproduction or underconsumption for their own financial gain. For instance, Californian fruit growers have, on occasions, refused* to

harvest the whole of their crop because they could obtain higher profits by withholding a part of their produce. These farmers have voluntarily created an unconsumed surplus production.

It is not the possibility that a portion of the supply may never be consumed which worries the farmer, it is the possibility that he may have to dispose of the whole of his supply in times of abundance at a low price. It is underprice and not overproduction about which the farmer is really complaining.

It may be remarked that genuine overproduction, that is the production of an unconsumable surplus of agricultural commodities, is a practically non-existent state of affairs. It may sound plausible that man can only eat and drink so much and that therefore the demand for agricultural commodities is inelastic, and unconsumable surpluses may arise. But this reasoning takes no account of certain very important facts about agricultural consumption. First, that among the human population very few consumers have reached satiety in all foods and many have not reached satiety in even the most prosaic foods such as cereals. Second, that the human population is not the only consumer of food products; animals, which themselves yield food, are also large consumers of agricultural staples; thus the potential consumption of cereals in the form of animal products is large. Third, that urban industry is a large and potentially larger consumer of agricultural products. Such products as cotton, wool and rubber go entirely to industrial consumers whose demand is elastic; milk also is used in the manufacture of many purely industrial products, while the scope for industrial utilisation of other agricultural commodities, particularly cereals, is enormous.

It may be stated that a permanent increase of 50 per cent. in the production of agricultural commodities could be easily consumed if offered at a sufficiently low price.

Most farmers will agree that it is low price, arising from alleged overproduction, which is the real cause for complaint. They maintain that they rightly require a "fair" price; a price which would permit them to continue their existing organisations and methods of cultivation and earn a moderate

profit. The use of the adjective "fair" is particularly appropriate because a leading economist in the past has discussed such a price in some detail. The unfortunate feature of the adjective is that it has a double meaning—the farmer uses one, the economist the other. The farmer means by "fair", equitable; the economist, sufficient, that is to maintain production in an averagely efficient and progressive state.

Actually the doctrine that the price of anything whether of commodities, labour, land or capital, should be fixed so as to be equitable for all concerned is comparatively new. The older idea was that everyone with anything to exchange, should drive the best bargain possible. The difficulty of putting the newer idea into practice is the difficulty of deciding what is an equitable price and what is not; to the seller a high price seems equitable, to the buyer a low price seems equally so.

The danger of attempting to fix the price of anything according to equity is that the individual enterprise is liable to be damped. The individual, who receives more than his due, will tend to become complacent; the individual who through no fault of his own receives less will feel frustrated. Neither frame of mind is conducive to energetic and self reliant enterprise.

This danger makes it improbable that a system of fixing prices arbitrarily will come into universal usage in the immediate future. For the present farmers will have to content themselves to a large extent with whatever price they can command. If the volume of production is great, consumers who are prepared to buy only at low prices will enter the market; the ruling price level will therefore be low. If low prices persist the farmers who are least fortunately situated and who are most dissatisfied can retaliate only in two ways, either by discontinuing production or by reducing costs of production to a level at which the ruling price is profitable. Most farmers because of the specialised nature of their occupation cannot withdraw from production; their only alternative is to attempt economies in production.

The problem the scientist has to solve when there is alleged overproduction consists therefore not of reducing the volume of production but rather of reducing costs. Since it

is the price *per unit* which is low, the problem is to lower the cost per unit. This cost can be reduced either by curtailing the customary expenditure in such a way that the yield is not proportionately reduced; or by incurring additonal expenditure in such a way as to secure a proportionately larger increase in yield.

Of the two methods whereby cost per unit can be reduced the first, the curtailment of expenditure, appears at first sight to be the more logical; when times are bad the natural procedure is to economise in expenditure wherever possible. In practice, however, this is not the soundest way of tackling the problem for the following reason. Only a small part of the expenditure incurred in an agricultural enterprise is for purely current operations, such as harvesting, which affect the enterprise at the time they are actually performed. Other operations such as cultivating, manuring, pruning, etc., are similar to the industrialist's expenditure for upkeep of capital: their effect is not temporary but influences the economy of subsequent production. In fact, the curt ilment of expenditure generally means the reduction of capital in the enterprise; the temporary effect of "living on capital" is of course to increase profits, but after the temporary effect has passed the enterprise is worse off than before. The enterprise is less efficient because it is more costly to produce anything with less capital productively applied. The policy of pulling in one's belt in agriculture in times of depression has therefore little to recommend it from the economist's point of view.

The alternative of increasing expenditure and more than proportionately increasing the yield, though difficult to achieve in bad times, is to be preferred. Additional expenditure can be incurred in one phase of production only, such as manuring, or it can be incurred generally in evolving more efficient methods of production such as the evolution of a superior yielding variety of a crop. The former avenue of increased expenditure can be undertaken by the farmer himself; the latter must be usually explored by some corporate scientific body. Both, of course, involve increased expenditure whether for the farmer's manures or the scientist's

salary: the source of funds to meet the expenditure, though naturally of interest to the farmer, does not affect the discussion.

Something should be said on the merits of these two approaches to increased expenditure. The farmer spending extra on manures or machinery is essentially increasing *existing* capital investments. The scientist through his services is generally applying capital in a new way; his task is that of evolving new methods of production by the evolution for instance of new superior varieties of crops.

Most people are aware that as capital is applied to one phase of agricultural production in increasing amounts it becomes less and less productive—that is, the profit from each fresh investment becomes less. The scope for increases in profit by successive applications of capital in one particular form is therefore limited, ultimately the position is reached when no increase in profit is obtained. If production in times of prosperity has been managed efficiently the maximum profit for all existing forms of investment should already have been obtained; under these circumstances additonal investment cannot result in higher profits or the arrest of any decline. In short, the farmer's only hope of increasing his profit by his own efforts in bad times is the careful scrutiny of previous expenditure he has incurred in good times; his hope is the discovery of wasteful expenditure in the past and the remedying of past extravagance.

The assistance the scientist can give to the farmer by the evolution of more productive methods of management can be very great. The capital represented by the scientist's work is applied in new ways. There would be scope in the application of capital in these new ways for far larger economies than from mere additions to existing capital investments. Further, the law of diminishing returns (decreasing profit from successive application of capital) does not operate so strongly—sometimes not at all—for initial investments in any particular form.

The scientist's efforts to increase yield are beneficial to the farmer and the community at large in another way. By increased yield it is possible to secure the same total produc-

tion from a smaller area of land. This smaller area will presumably be the most suitable, so that the average quality of the land under cultivation will be increased. The land thrown out of cultivation may be a complete loss if it is abandoned, and the capital invested in it will deteriorate to nothing. More often, however, only part of the capital is lost because the land can be converted to the cultivation of some less exacting crop. Not only is the efficiency of the main crop increased because of better quality land, but the efficiency of the less exacting substitute crop is also enhanced. The land discarded for the main crop must obviously be more suitable for the substitute than any previously used so that the average quality of the substitute land is also increased in the process of improving the main crop.

Thus the apparent absurdity of remedying alleged overproduction by apparently increasing production is actually sound when examined in detail. Overproduction is really under price, and low price can be most effectively countered by increasing yield (not necessarily production). In fact, the increase of yield by the evolution of new methods of production is the most fruitful way of decreasing costs.—*Tropical Agriculture.*

SPARE THE CROSS WORD!

Umpteen down.—A six-letter word, denoting a grain insect, beginning with W and ending invariably in L (unless it is controlled).

Get a handy copy of Bulletin No. 1161 (*Control of Maize Weevil*), and remember that

CLEANLINESS AIDS INSECT CONTROL.

The Farm Home

Jam Making

By Miss E. E. Coutts.

As a rule jam making is one of the most popular methods of fruit preservation in the home and one that is easily carried out by all. In spite of this there are some failures, and housewives who pride themselves on their jam making are faced with the fact that a particular jam has been a failure.

A good jam should:—

(1) Keep well.

(2) Be clear and bright in colour.

(3) Set well without being too stiff.

(4) Have a fruity flavour.

Every jam maker finds difficulty at times even when using a well-tried recipe. Materials vary considerably, *e.g.*, the fruit will vary according to variety, season and ripeness; pans differ in shape and size, therefore there is a variation in evaporation.

To obtain a good set in jam making it is necessary to have:—

(1) The presence of "setting" material or pectin in sufficient quantity.

(2) Acid in sufficient quantity.

(3) Sugar.

Above all these three in the right proportions.

FRUIT.

The fruit should be:—

(*a*) Just ripe. If fruit is unripe the flavour in undeveloped, colour poor, and pectin is in an insoluble form and difficult to extract. In over-ripe fruit the pectin changes and causes an unsatisfactory "set."

(*b*) Fresh, wholesome and in good condition. Unsound fruit will spoil the keeping properties of the jam.

(*c*) Dry.

Fruit should be picked in dry weather. In jam making the first object is to extract the pectin from the fruit. This is most easily done when fruit is slightly under ripe; the presence of acid in the fruit helps in this extraction. Fruit which is rich in pectin and acid is easy to convert into jam, *e.g.*, some plums. Other fruit is the reverse, *e.g.*, strawberries. In the latter case the addition of acid in the form of lemon juice assists in making a successful jam. *The acid is necessary*

(1) To help bring pectin into solution.

(2) To brighten the colour.

(3) To improve the flavour.

(4) To prevent the sugar recrystallizing.

In most jam making it is better to cook the fruit for some time before the sugar is added; this extracts the pectin, softens the fruit and drives off some of the moisture. Hard fruits such as quinces should be cooked with water and simmered gently from $\frac{1}{2}$—$\frac{3}{4}$ hour. Or cook until about one-third of liquid has evaporated.

Acid may be added as follows: Lemon juice, 2 tablespoonsful, 2 lbs. fruit; tartaric or citric acid, 1 level teaspoonful, 2 lbs. fruit. Too much acid may cause "weeping jem."

SUGAR.

Sugar plays an important part in jellying of jam. The percentage of sugar present must be sufficient to prevent growth of moulds and yet not sufficient to cause crytallization. The proportion for jam is usually 1 lb. sugar, 1 lb. fruit. If convenient heat sugar beforehand; stir after adding until thoroughly dissolved. Never add sugar to fruit which is boiling quickly. When sugar is dissolved avoid stirring more than absolutely necessary. Do not allow jam to boil until all sugar is dissolved, then boil fast.

Sugar added before pectin is extracted sufficiently spoils the jam as:—

(1) Skins of fruit become tough.

(2) Too much water is required and the long boiling required to evaporate it spoils the colour and destroys the pectin.

(3) Caramilisation of sugar through long boiling gives a poor colour.

(4) Flavour is spoilt.

TIME OF COOKING.

This varies, but the rule which guides is that jam will not set until pectin and sugar are in right proportions and to ensure this sufficient moisture must be driven off. Jam should not require boiling longer than 30-40 minutes after the sugar is added.

TO TEST.

(1) *Cold Plate Test.*—Cool a little jam on saucer or plate. The surface should set and crinkle when pushed with finger. Care must be taken when using this method to see that jam does not pass the "setting" point during test.

(2) *Flake Test.*—Dip clean wooden spoon into jam, remove and turn horizontally until jam on spoon is cooled. (Not over hot pan.) Then allow to drop from edge. If boiled sufficiently drops run together forming flakes which break off in a clean sharp manner.

(3) *Temperature Test.*—Boil to 220° F. on dairy thermometer after sugar is added. A slightly lower degree when altitude is above sea level.

Finishing of Jam.—When the setting point is reached jam should be taken from fire and scum removed quickly with clean silver spoon. Pour immediately into perfectly clean, dry warm jars and fill to the top to allow for shrinkage, which always takes place. In a jam with small berries, *e.g.*, strawberry, to prevent the berries from rising after bottling allow jam to cool in pan until skin forms, then stir gently and pour into jars. Cover surface with wax circle and tie down immediately or leave till *quite* cold to cover.

FAULTS IN JAM AND SOME OF THE CAUSES.

I. *Fermentation is caused by*:—

(*a*) Too little sugar.

(*b*) Too little boiling.

(*c*) Fruit containing too little pectin or acid.

II. *Crystallization is caused by*:—

(*a*) Too much sugar.

(*b*) Too much boiling.

(*c*) Too much stirring whilst boiling.

(*d*) Leaving a large jar of jam open for a long time.

III. *Mildew is caused by*:—

(*a*) Pouring jam into damp bottles.

(*b*) Tying down when neither hot nor cold.

(*c*) Insufficient sealing.

(*d*) Storing in damp place.

(*e*) Fruit picked in rain.

IV. *Syrupy or running jam is caused by*:—

(*a*) Overboiling with sugar.

(*b*) Deficiency of acid.

(*c*) Wrong proportions of sugar and fruit.

Since the scientific study of jam making has been introduced it has been discovered that pectin may be extracted from fruit rich in it and stored and used as an addition when jam is made from fruit which is lacking in pectin. This assists the jam maker considerably. It ensures a good set, reduces the time of boiling considerably and therefore produces jam which is of a good colour. In addition, owing to the short time of boiling there is less evaporation and therefore a greater bulk of jam when finished.

There are various makes of this commercial pectin on the market. The following ones have been used successfully by the writer: Certo, the pectin in liquid form; Membrose, the pectin in powder form; Zett, the pectin in powder form. In every case the instructions sold with the product must be carried out carefully to give a good result.

The following hints may be of use to housewives who wish to send an exhibit of jam to Agricultural Shows. Marks are awarded as follows:—

I. *Appearance of container*.—(*a*) Method of tying down; (*b*) label (name, date, etc.).

II. *Appearance of Contents*.—(*a*) Colour; (*b*) suspension of solid matter throughout jars.

III. *Consistency*.—(*a*) Syrup; (*b*) any crystals; (*c*) soft skins.

IV.—*Flavour*.

The Manufacture of Cheddar Cheese

By The Dairy Branch.

Introduction.—Cheese is acknowledged to-day to be one of the most valuable foodstuffs and its importance in the diet and its advantage as a substitute for meat, particularly in hot climates, is becoming more and more realised. The value of cheese both from the economic and nutritional points of view is shown by the fact that one pound of cheddar cheese is equal in food value to two pounds of beefsteak or twenty-five eggs (average size) or over six pounds of chicken; whilst pound for pound cheese contains five times as much mineral salts as beef. The briefest study of comparative costs will show that cheese is by far the cheaper food. It is well known also that good cheese eaten with bread and butter forms a very wholesome diet and the worth of this valuable foodstuff in time of war or in any emergency when fresh meat cannot easily be obtained is fully recognised. Many people complain that cheese is indigestible, but while the charge may be admitted against an unripened article it is certainly not true of well matured cheese, which is very easily digested. Whilst the consumption of cheese per head in Southern Rhodesia compares quite favourably with that of other countries, there is little doubt that the demand for this commodity could be greatly increased provided the consumer were always assured of cheese of first grade quality. Since the introduction, some seven years ago, of the compulsory grading of cheese the quality of Rhodesian cheese, particularly cheddar, has shown a considerable improvement, and it is of interest to note that during this same period the consumption of this product within the Colony has shown a remarkable increase.

There is actually no reason why the percentage of first grade cheese manufactured in the Colony should not approximate 100%, for experience has shown that this figure can be very nearly attained provided the proper facilities and equip-

ment are available and the necessary care and attention exercised in the production of the milk and in the subsequent manufacture and handling of the cheese.

In Southern Rhodesia the only varieties of cheese of commercial importance are cheddar and gouda, chiefly the former, although soft varieties, such as cream cheese, are also made on a limited scale. It is proposed to deal with the manufacture of cheddar cheese, but before doing so it would be advisable to indicate briefly the requirements of the Dairy Act in relation to the manufacture and sale of cheese in this Colony.

REQUIREMENTS OF THE DAIRY ACT IN RELATION TO THE MANUFACTURE AND SALE OF CHEESE.

Cheese Levy.—The Dairy Industry Control Board is empowered under the Dairy Act, 1937, to impose a levy, not exceeding 1½d. per pound, on all cheese made in or imported into the Colony, except cheese made by any person for consumption by his own household. In the case of cheese which is made in a registered cheese factory, the levy has to be paid at the end of each month on the monthly manufactures of green cheese, less 10%, which is allowed for shrinkage. In the case of a farm cheese dairy, the levy has to be paid quarterly on the actual weight of cheese sold. Producers who require further information on this subject should write to the Secretary, Dairy Industry Control Board.

Registration of Dairy Premises.—The Dairy Act makes provision for the registration of all premises used for the manufacture of cheese. Two kinds of premises are recognised:

(1) *Cheese Factories.*—A cheese factory means any premises used for the manufacture of cheese at which the owner or occupier uses milk obtained or purchased from another person or of which the owner or occupier is a co-operative society or company or a syndicate or partnership or three or more persons. All cheese factories have to be registered.

(2) *Farm Cheese Dairies.*—A farm cheese dairy is any place where cheese is made for sale other than a registered cheese factory. In the case of farm cheese

dairies which are situated in rural areas, registration is not yet operative and will not come into operation until a date to be fixed by the Minister of Agriculture and Lands.

All cheese factories and farm cheese dairies have to comply also with the requirements of the Dairy Regulations contained in Government Notice No. 899 of the 31st December, 1937.

These Regulations require that milking operations shall be carried out in a cleanly manner and in an approved milking place; a supply of pure wholesome water must be provided as well as proper facilities for the cooling of milk and for the washing, boiling and steaming of all dairy utensils. All utensils have to be of approved type, and in the case of cans, buckets and similar receptacles, must be of seamless construction. Special and separate rooms have to be provided for making and for storing and curing the cheese. These rooms must possess certain essential features, such as a cement floor and a ceiling and must be fly-proof and rat-proof and be adequately ventilated and drained. In addition to these requirements, registered factories have to be provided, to the satisfaction of the Dairy Officer, with sufficient accommodation and with all necessary appliances and equipment for the manufacture of cheese, and such equipment must include a steam boiler. Premises used for the manufacture or storage of cheese must be situated at least 100 feet from any milking place and at least 300 feet from any piggery or manure heap.

Marking of Cheese.—All cheddar cheese must be marked with letters or figures indicating the date of manufacture of the cheese, the number of the vat, if more than one vat of cheese is made on any one day and the number of cheeses from each making, *e.g.*, A.24

1

10

A would represent the month of the year—say, January

1 would represent the number of the vat

10 would represent the number of heads of cheese made on that date in that vat.

Fig. 1.—Where cheese making begins.

The letters used for indicating these particulars should be not smaller than one inch square.

Grading.—All cheddar cheese has to be graded and marked according to grade by a Dairy Officer before it can be sold. Except in special circumstances, cheese is not graded until it is six weeks old. Four grades are recognised—First grade, Second grade, Third grade and Below grade. Owners of cheese factories or farm cheese dairies are not entitled to have their cheese graded more frequently than once a month.

Storage and Transportation.—Cheese in transit or which is kept in a curing room or in a shop, store or other place, must be kept at such temperature as will prevent the loss of any of the fat in the cheese.

Cheese which is held in a cold store must, unless otherwise approved by a Dairy Officer, be kept at a temperature not below 35° F. or above 55° F. A Dairy Officer may refuse to grade cheese which is not kept in accordance with these requirements.

Standards of Composition for Cheddar Cheese.—

(*a*) It shall contain no fat or oil other than milk fat.

(*b*) It shall contain no mycobacterium tuberculosis.

(*c*) It shall contain not less than 45 percentum of milk fat in its water free substance.

Further information regarding the requirements of the Dairy Act and the Dairy Regulations can be obtained from the Chief Dairy Officer, Department of Agriculture and Lands, Salisbury.

GENERAL REQUIREMENTS FOR SUCCESSFUL CHEESE-MAKING.

For successful cheese-making certain essential requirements have to be fulfilled. These are as follows:—

1. **The Milk must be of satisfactory quality.**—It is an indisputable fact that the best cheese cannot be made from milk of inferior quality. Even the most highly skilled cheese-maker cannot produce really good cheese from milk which comes from unhealthy or underfed cows or which has been

produced and handled in an unhygienic manner. This fact cannot be too strongly emphasised.

Cheese-making commences at the milking shed and the cheese-maker or dairy farmer, as the case may be, should see that every precaution necessary for the production of clean milk has been observed before the milk reaches the factory or cheese vat. For information on this subject dairymen are referred to Bulletin No. 1051, "The Production and Handling of Milk and Cream," which deals with the subject in detail. A recapitulation of some of the more important precautions to be observed may, however, be of service.

(i.) Milking operations should be carried out in a cleanly manner and in clean, dust-free surroundings. Infection from a dusty atmosphere can be a potent source of trouble, and this applies also to contamination caused by particles of dung, food, loose hairs which fall into the milk-pail from the cow's flank and udder. The cow's udder, flanks and tail should always be wiped with a damp cloth before milking and the milker should wash his hands before milking each cow.

(ii.) Feeds liable to taint the milk, such as ensilage, should always be fed after milking. In fact, fermented feeds of this type should be fed with caution, as they are liable to impair the quality of the cheese.

(iii.) The cows must have access to pure drinking water and should not be allowed to wade and drink in muddy, stagnant pools or sluggish streams. Stagnant pools into which cows can walk are usually fatal to cheese-making; gassy curds and liquifying fermentations are frequently traceable to waterholes of this description.

(iv.) All milk buckets and cans, etc., must be of seamless construction and should be properly cleaned and thoroughly sterilised by boiling or steaming immediately after use. The proper cleaning and sterilisa-

tion of all utensils, including the cheese vat, is an essential precaution for the manufacture of good cheese.

(v.) The milk should be cooled immediately after being drawn from the cow. Cooling is particularly necessary where milk is sent to a cheese factory and may be an hour in transit. This precaution is hardly ever observed with the result that when the milk arrives at the factory fermentation—usually of an undesirable nature—has already commenced.

(vi.) Abnormal milk should never be used for cheese-making, *e.g.*, colostrum or milk from sick cows or from cows suffering from mastitis. Cheese-making will reveal the use of this milk very quickly—in fact, in some cases of abnormal milk the rennet will not act.

Failure to observe the foregoing precautions will invariably result in inferior cheese which will puff or leak in the curing room or else develop strong objectionable flavours and odours. Cheese makers who wish to avoid these or similar defects will make it a regular practice to test the milk so as to ascertain its suitability for cheese making. For this purpose various tests are used, of which the following are probably the best known.

1. *Methylene Blue Reductase Test.*—This test, when used in conjunction with the Fermentation Test or Curd Test, gives a good indication as to the bacterial quality of the milk and its suitability for cheese making. In this test use is made of the fact that the bacteria in milk possess the ability to decolourise Methylene Blue dye. 1 c.c. of standard solution of the dye is added to 10 c.c. of the milk to be tested and the latter is then kept at a temperature of 100° F. until the blue colour in the milk has disappeared. The rapidity with which the milk is turned white is considered to be an indication of the number of bacteria present. The more bacteria the milk contains, the quicker the blue colour will disappear.

The apparatus required for this test consists of a small water bath or tank in which the milk samples to be tested are kept at a temperature of 100° F., this temperature being

usually maintained by means of a small spirit-burner or an electric heating unit. Standard test-tubes, pipettes and Methylene Blue Solution should be used, and these items together with full instructions are supplied with the complete outfit for this test. It is essential also that all pipettes, test-tubes, corks, etc., should be properly sterilised before use; for all practical purposes this can be achieved in a cheese factory by boiling all glassware, etc., for 30 minutes to 1 hour immediately before use. If the samples of milk to be tested are taken at the factory in the morning, as is usually the case, then they should be kept at a temperature of about 65°-70° until 5 or 6 p.m. on the same day, when they are ready for testing. As it is not usually practicable to commence the test at this hour, the samples are held overnight in a refrigerator at a temperature of 35-40° F., the test being carried out the following morning. Samples which are taken at the factory in the evening are not placed in a refrigerator but are merely held overnight at room temperature and are tested the following morning. Evening milk sent to the factory the following morning is ready for testing when delivered at the factory. During the operation of the test the test-tubes containing the milk and dye are inverted at half-hourly intervals.

Milk which has been produced and handled in an hygienic manner should not decolourise under six hours. A good average is five hours. Milk which decolourises in less than three hours and which shows gassiness or other defects in the fermentation or curd test is not suitable for the manufacture of the best quality cheese.

2. *The Fermentation Test.*—This test is considered to give an indication of the types of bacteria present in the milk. The same samples which are used in the Methylene Blue Test are left in the water bath for a further 20-24 hours at a temperature of 100° F. and are then examined. A smooth, solid coagulation showing no signs of gas or liquefaction of the curd usually indicates the presence of desirable types of organisms, whilst the presence of gas bubbles, a floating curd or liquefaction denotes milk of inferior quality which is unsuitable for cheese-making. See fig. 18. Fermentation of this type denotes carelessness in producing and handling the milk.

3. *The Curd Test.*—This is another form of the Fermentation Test. The best known curd test is perhaps the "Wisconsin Curd Test." Samples of the milk to be tested are collected in sterile, wide-mouthed pint bottles and warmed up to a temperature of 95°-100° F. Ten drops of rennet are then added to each bottle and when the milk coagulates, *i.e.*, in about 10-15 minutes, the curd is broken up either by shaking, the lid of the bottle being closed, or by stirring with a sterile knife. Shaking is usually preferred. The whey which separates from the curd is then poured off from time to time until the curd is fairly dry and forms a small pat which is then held for a further 12-16 hours (usually overnight) at a temperature of 98°-100° F. Each pat of curd is then cut in two with a sharp knife and examined. A smooth solid surface and a clean acid, small usually, indicate milk of satisfactory quality for cheese-making. On the other hand, a rough spongy, or slimy curd with gas bubbles and a disagreeable odour, denotes the presence of bacteria, which can be expected to cause undesirable conditions in the cheese.

The following is another Fermentation or Curd Test:—50 cc. samples of the milk to be tested (about 2 ounces) are collected in test-tubes or suitable bottles and 2 cc. added of a diluted rennet solution. The tubes or bottles containing the milk are then kept at a temperature of 100° F. for 12 hours. The curd is then removed from the whey, cut and examined.

2. **The Buildings and Equipment must be suitable for the purpose.**—The best cheese cannot be produced without suitable buildings and equipment. In the case of a small farm cheese dairy, the building may consist of two adjoining rooms with a floor space of 16 ft. x 14 ft., one room being used for curing the cheese and the other being used as a making room. Washing up facilities are best placed on the verandah, which for the sake of coolness should surround the entire building.

For a registered cheese factory a more elaborate building is usually required; large factories should have a milk receiving room as well as packing and storage rooms. A special room for the preparation and handling of starters is also essential.

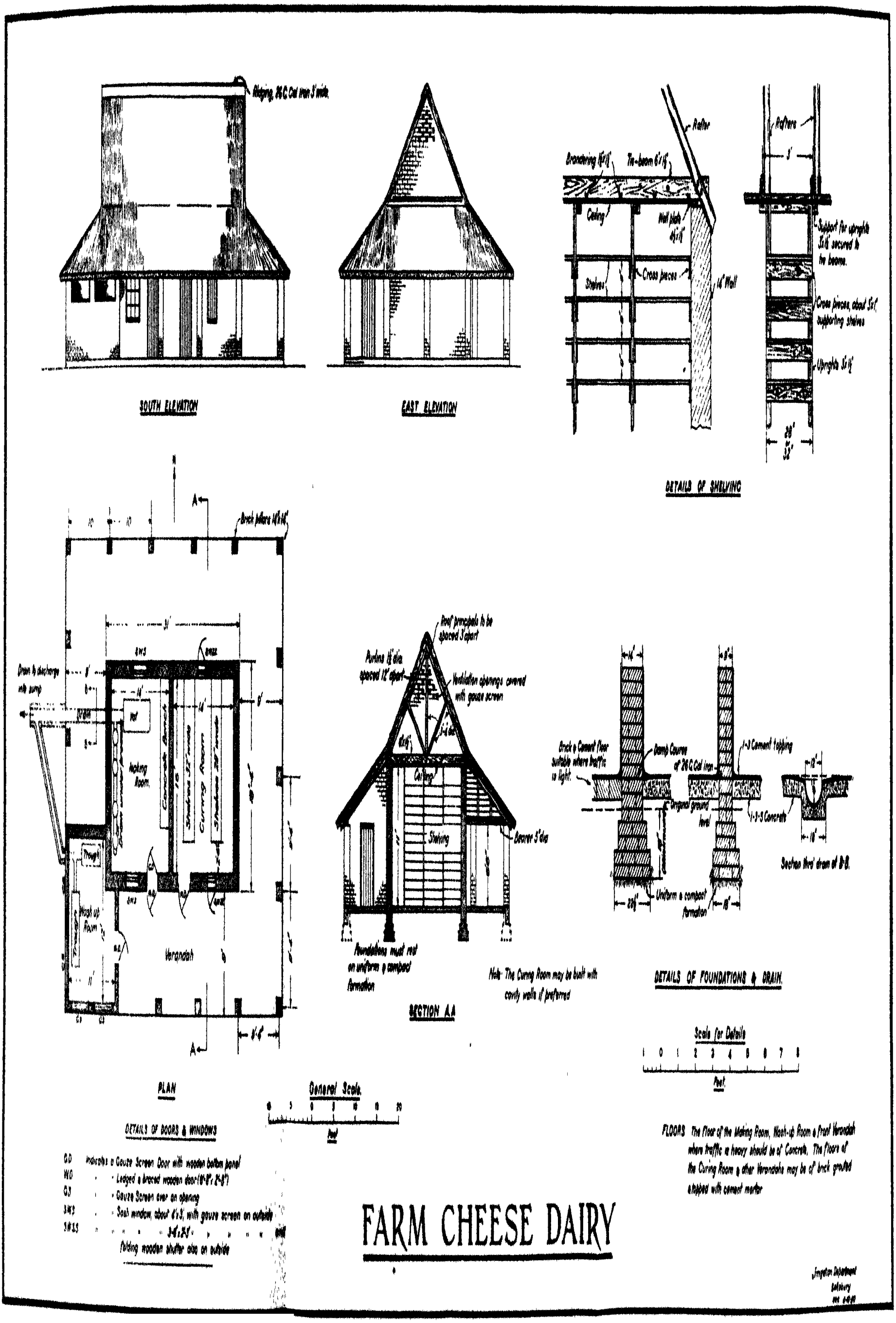
The floors throughout should be constructed of cement and be properly drained. The building must be designed and situated with a view to securing the maximum degree of coolness. This applies particularly to the cheese curing room.

Smooth plastered walls that can be easily white-washed are quite satisfactory, but for preference the walls should be tiled or cemented up to 4 ft. or 5 ft. from the ground to facilitate washing. Drawings of suitable types of buildings for a registered cheese factory and farm cheese dairy can be obtained from the Chief Dairy Officer, Department of Agriculture and Lands, Salisbury. Fig. No. 1 illustrates a suitable type of building for a farm cheese dairy.

Whilst good cheese can be made with make-shift utensils, modern appliances facilitate labour and assist in the production of a more uniform article. If, therefore, cheese making is to be practised regularly, it is advisable to purchase the necessary utensils and equipment at the beginning.

The following list indicates the equipment required for converting up to 200 gallons of milk daily into cheddar cheese:—

1 Boiler, 2-4 h.p.
1 Jacketted cheese vat (200 gallons).
1 pair curd knives ($\frac{1}{4}$ in. to $\frac{3}{8}$ in. cut).
1 Large cheese knife.
1 Rake.
2 Wooden racks.
1 Curd mill.
2 Cheese presses (vertical type) with weights.
1 Set platform scales.
1 Small balance (to weigh salt, curds, etc.).
1 Curd scoop.
1 Curd bucket.
1 Acid testing outfit.
1 Marshall Rennet Tester.
2 Seamless starter drums.
2 Cream stirrers.
6 40 lb. Cheese moulds.



Ridging, 26 G. Gal iron 3' wide.
SOUTH ELEVATION
EAST ELEVATION
Rafter
Brandering
Tie-beam
Ceiling
Wall plate
Shelves
Cross pieces
14" Wall
Rafters
Support for uprights secured to tie beams.
Cross pieces, supporting shelves
Uprights
DETAILS OF SHELVING
Brick pillars 14"x14"
Drain to discharge into sump
Drain
Vat
Making Room.
Curing Room
Trough
Wash up Room
Verandah
PLAN
Roof principals to be spaced 3' apart
Ventilation openings covered with gauze screen
Ceiling
Shelving
Bearer 5" dia
Foundations must rest on uniform & compact formation
SECTION AA
Note: The Curing Room may be built with cavity walls if preferred
Brick & Cement floor suitable where traffic is light.
Damp Course of 26 G. Gal iron
1-3 Cement topping
Original ground level
1-3-5 Concrete
Uniform & compact formation
Section thro' drain at B-B.
DETAILS OF FOUNDATIONS & DRAIN.
Scale for Details
Feet.
General Scale.
Feet
DETAILS OF DOORS & WINDOWS
G.D indicates a Gauze Screen Door with wooden bottom panel
W.D Ledged & braced wooden door
G.S Gauze Screen over an opening
S.W.S Sash window, with gauze screen on outside
S.W.S.S folding wooden shutter also on outside
FLOORS The floor of the Making Room, Wash-up Room & Front Verandah where traffic is heavy should be of Concrete. The floors of the Curing Room & other Verandahs may be of brick grouted & topped with cement mortar
FARM CHEESE DAIRY
Irrigation Department Salisbury

Fig. 2.

15 20 lb. Cheese moulds.
10 10 lb. Cheese moulds.
1 Wash up vat.
1 Hot water vat.
1 Steam sterilising cabinet.
Bandage, caps, salt, scrubbing brushes and cleansing agents plus ample supplies of hot and cold water.

The cost of these appliances varies considerably, but 's usually in the vicinity of £1 for each gallon of milk handled. For a factory handling 200 gallons of milk per day, the cost of the necessary equipment would therefore be approximately £200-£250.

3. **Care and skill must be exercised in the Cheese-making Process and proper attention given to the treatment of cheese after manufacture.**—Considerable skill and experience is necessary for the production of cheese of uniformly good quality. This applies particularly to factory cheese. When the cheese-maker is handling his own milk or the milk from only one herd, experience will teach him how it will work from day to day and he has thus a great advantage over his colleague in a large factory with several or numerous suppliers and ought always to produce a better article because of the control he has over the milk from the time it is drawn from the cow.

Proper control of acidity, moisture and temperature during the cheese-making process is of the utmost importance as far as the quality of the cheese is concerned, and it is here that the cheese-maker's skill and experience is of especial value.

In this Colony conditions may vary from week to week, or even from day to day, and considerable experience and judgment is required in making the necessary adjustments in the cheese-making process to provide for these daily, weekly or seasonal variations. However, it must be emphasised that skill and experience should not be regarded as substitutes for good quality milk and that whilst it may at times be feasible for a skilled cheese-maker to produce a fair quality, saleable cheese from somewhat inferior milk, it is not possible for him, even with the best of equipment, to produce an article of

consistently good quality from unsatisfactory raw material; a combination of good milk, skilful technique and proper equipment is necessary for the production of the best quality cheese.

4. **The Rennet, colouring and salt must be of the best quality.**—Rennet is used in cheese-making to coagulate the milk. It is not commonly realised that the use of weak or inferior rennet is liable to result in serious defects in the cheese, and for this reason only the best rennet of known strength should be used. If up to strength, one part of rennet should coagulate 10,000 parts of normal sweet milk at 95° F. in 40 minutes. The strength of the rennet can be quite easily tested as follows:—

> "Mix 1 cc. of the rennet with 9 cc. of distilled water or rain water. Add 1 cc. of this rennet solution to 100 cc. of normal sweet milk at a temperature of 95° F. Stir thoroughly, carefully noticing the time when the rennet was added. If the rennet is up to strength, coagulation should take place in about 4 minutes; provided, however, that coagulation does not take longer than 5 minutes the rennet may be regarded as being of satisfactory strength."

Rennet loses its curdling properties on keeping or when exposed to the sunlight or high temperatures. For this reason it should not be kept too long and should always be stored in a cool, clean dark place. If the cheese is not being made in large quantities it is advisable to buy the rennet in small amounts to ensure the supply being fresh. Liquid rennet is to be preferred to the powdered form.

Alkaline substances, when added to rennet, destroy its coagulating power, and for this reason receptacles in which rennet extract is handled should be free from soap or alkaline washing powder. The glass container used for measuring cheese colour, a strongly alkaline liquid, should not be used for rennet extract without thorough washing. In fact, it is preferable to use a separate measure for the rennet.

Cheese colouring keeps fairly well if not frozen. If a sediment forms it should not be shaken up for use.

The salt used should be clean and of a high grade of purity. For cheese-making purposes the salt should be flaky, free from lumps and somewhat coarse grained. The salt should always be kept in a clean dry place.

5. **All tests for acidity must be accurately carried out.**—Reference is made elsewhere to the importance of acidity in the cheese-making process, and it is shown that a certain amount of acid has to be developed in the milk, whey and curd in order to give the characteristic flavour, texture and body to the cheese. Furthermore, this acidity has to be developed in certain amounts at different stages of the process as too much or too little acidity at any particular stage may seriously impair the quality of the cheese.

It is essential, therefore, that some accurate and reliable tests be used to determine the acidity at the different stages of the process and it is, of course, equally important that these tests should be carefully and accurately carried out.

The following are the tests most commonly employed:—

(i.) *Monrad Rennet Test.*—This test is used to ascertain whether the milk is sufficiently acid or ripe enough to add the rennet.

The only apparatus required is a watch with a second hand, a tea cup, a dram of rennet, a measuring glass and a teaspoon. Measure out 1 dram of rennet and place in the tea cup with a few pieces of burnt match or particles of cork. These act as an "indicator." The cup should be slightly warm. Four ounces of the milk, at a temperature of 86° F. are then poured on to the rennet, the exact time noted and the whole then stirred for 5 to 10 seconds. The exact time when the pieces of match or cork cease to rotate is then taken. The number of seconds from the time of adding the milk to the rennet to the time when the pieces of match or cork stop moving, gives the test. The greater the acidity in the milk, the more rapidly the milk curdles with the rennet and the shorter the time required for the pieces of match or cork to stop revolving.

Generally speaking, a test of 20-22 seconds indicates that the milk is ripe enough for rennetting.

(ii.) *Marshall Rennet Test.*—This test is also used to determine whether the milk is ripe enough for rennetting.

The apparatus consists of an enamel cup with a small aperture in the bottom and graduated on the inside into a scale of 10 divisions extending from the top to the bottom, with the zero mark about ½ inch from the upper edge of the cup. The cup is filled with milk at a temperature of 86° F. and set in a level place, usually on the side of the cheese vat. The milk is allowed to run freely from the cup until it reaches the zero line on the scale, when a rennet solution consisting of 1 cc. of rennet in 10-15 cc. of cold water is quickly poured into the milk and stirred for 10 seconds. The milk will continue to flow from the cup until coagulation occurs. The amount of milk which runs out will vary in inverse proportion to its acidity, *i.e.*, the less acid in the milk the longer it takes to coagulate and the more will run out from the cup. The ripeness or rennet test of the milk is expressed in terms of the number of divisions on the scale uncovered by the milk before it coagulates. Experience has shown that under summer conditions —and with rennet of standard strength—the milk is sufficiently ripe for rennetting when 6-7 spaces are exposed and during the winter months when 4-5 spaces are uncovered.

Obviously the reliability of these two tests depends on the strength of the rennet used, and care should be taken, therefore, to see that the rennet is up to standard strength.

(iii.) *The Acidimeter Test.*—This test is for determining the acidity of the milk or whey or the starter.

The apparaus required consists of a burette graduated to measure 1/10 of a cubic centimeter, a 9 cc. pipette, a small porcelain dish or cup, a drop

bottle of indicator solution (*phenol-phthalein) and a supply of tenth normal caustic soda.

The burette is filled to the zero mark with the caustic soda solution; 9 cc. of the milk or whey to be tested are measured into the porcelain dish or cup with the pipette and 2 or 3 drops of indicator added. The caustic soda is now added slowly from the burette, the milk or whey in the dish being stirred meanwhile. When sufficient caustic soda has been added to neturalise the acid in the milk or whey a permanent pale pink tinge should appear. The quantity of caustic soda used is then carefully read off the burette and this figure divided by ten is considered to give the amount of acidity of the milk or whey expressed as lactic acid, *e.g.*, if 2 cc. of caustic soda are used then the acidity of the milk or whey is stated to be as 0.2 per cent. of lactic acid.

This test has the advantage that it can be used at all stages of the cheese-making process—before adding the rennet, drawing off the whey, etc.—and may also be used to test the drainings from the press and to test the acidity of the starter. When testing the ripeness of the milk for rennetting, however, it is always advisable to use the test in conjunction with one of the other two rennet tests already described. The caustic soda solution should not be exposed to the air, otherwise it will deteriorate; the bottle of caustic soda should be tightly corked and a small cork should also be placed in the burette and tightened each time after use. The burette, pipette, etc., should be kept clean.

(iv.) *The Hot Iron Test.*—This test is used to ascertain when to remove the whey from the curd or to determine when the curd should be milled. A piece of iron 1 inch to 2 inches wide and ½ inch thick and

***Note.—(Tenth Normal Caustic Soda Solution for use in cheese factories, etc., can be obtained from the Department of Agriculture, Salisbury, on application to the Chief Dairy Officer. The solution is supplied at 1s. 6d. per whisky bottleful, i.e., ¾ of a litre. Containers in which to pack the bottle of solution must be supplied by the purchaser.)**

about 2 feet long is placed in a fire and heated to a black heat and then carefully wiped with a cloth until it is clean and smooth. A handful of curd is then squeezed by hand in a dry cloth until most of the whey has been expelled. The curd is then rubbed lightly with a circular motion on the iron—which should be just hot enough to brown but not blacken the curd. The curd is then gently drawn away from the iron. If the correct degree of acidity has been reached it will be seen that thin silky threads extend from the iron to the piece of curd. The length and fineness of these threads before they break from the curd are reliable indications of the acidity of the curd. The length varies from $\frac{1}{8}$ inch-$\frac{1}{4}$ inch when drawing off the whey from the curd to $1\frac{1}{4}$ inch to 2 inches at the milling stage. This is a test, the carrying out of which requires practice. The iron should always be of the proper heat and must be free from dirt and grease; it should also be held in such a position that it can be kept steady; the test should not be performed in a draught otherwise the threads are liable to break.

6. **The starter used should be free from gas, have a clean acid smell and be vigorous in action.**—The necessity for using a good, clean, active starter cannot be over-emphasised. In fact starters are of such importance in cheese-making that it is necessary to devote a special chapter to the subject.

FUNCTION, PREPARATION AND TREATMENT OF THE STARTER.

A starter may be defined as a culture of lactic acid producing bacteria. These bacteria when inoculated into milk or cream will cause souring or produce acid by converting the lactose or milk sugar in the milk or cream into lactic acid.

To appreciate the function and importance of a starter in cheese-making, it is necessary first of all to understand the role played by acidity in the cheese-making process.

In the manufacture of hard pressed cheese of the cheddar type, acidity is required for the following purposes:—

(i.) Acidity is necessary to obtain a satisfactory coagulation of the milk with rennet. Every cheese-maker knows that a more rapid and satisfactory coagulation can be secured by allowing the milk to develop a certain amount of acidity before adding the rennet.

(ii.) After coagulation has taken place and the curd has been cut, acidity is necessary to assist in firming up the curd particles. This firming up process is accelerated by the development of acidity in the particles of curd in which the acid producing bacteria are concentrated when the curd is cut.

(iii.) Acidity is also necessary for the particles of curd to mat and fuse together so as to produce the characteristic body and texture which is required in this type of cheese. Without the required amount of acidity the curd particles will not mat together properly and the cheese will not have the desired physical properties.

(iv.) It is well known also that at ordinary temperatures acid producing bacteria of the type desired in cheese-making will usually outgrow all other types of organisms commonly found in milk. In cheese-making acid production plays an important part in suppressing the development of undesirable types of bacteria such as those which cause putrefactive or gassy fermentations; in fact, if the milk is gassy, the cheese-maker's only hope of making a marketable product is to develop sufficient acidity to suppress the gas forming organisms.

(v.) Finally, the acid producing bacteria are considered to play an important part in the breaking down or ripening process of the cheese and are also believed to be of assistance in producing the desired flavour. It is clear, therefore, that in the manufacture of cheese of this type the development of acidity constitutes an essential part of the cheese-making process. The function of the starter is to produce this acidity.

In order, however, to perform this extremely important function the cheese-starter must fulfil certain essential requirements. These are as follows:—

1. **The Starter must contain the right types of Bacteria.**—In practice this requirement can usually be met by the use of commercial cultures and the exercise of proper care in the preparation and handling of the starter in the factory.

Commercial cultures of the desired acid producing bacteria are obtainable in either liquid or powder form.

Powder cultures have quite good keeping qualities but possess the disadvantage that a considerable number of transfers are necessary before the culture is fit for use and, furthermore, contaminating organisms are frequently present. The date before which the culture should be used is usually stamped on the bottle containing the culture powder.

Liquid cultures, which are usually put up in sterilised milk, have poor keeping qualities due to the fact that the bacteria are in a medium in which they can grow and multiply until checked by the acid they produce. On the other hand, liquid cultures have the advantage that they are active and should be fit for use after a couple of transfers.

2. **The Starter must be Active and Vigorous.**—The main function of a starter is to produce lactic acid, and it is essential, therefore, that the starter should be active so that there may be vigorous and uninterrupted development of acidity throughout the cheese-making process. Slow starters which are unable to suppress undesirable fermentations usually result in defective or inferior cheese.

3. **The Starter must be free from Contamination.**—The greatest of care must be exercised in the preparation and propagation of the starter, otherwise the latter may become contaminated with organisms capable of causing undesirable fermentations. The presence of such contaminating organisms is frequently not evident during the cheese-making process but is revealed by the development of strong off-flavours and odours in the cheese during the ripening process. To avoid the introduction of contaminating organisms all utensils which are used in propagating the starter must be thoroughly

cleaned and sterilised. The necessity for using milk of only the best quality for starter making is emphasised elsewhere. Such milk must be properly sterilised.

Liquid cultures for starters for cheese-making are obtainable, free of charge, from the Chief Dairy Officer, Department of Agriculture and Lands, Salisbury. These cultures are issued once a month only. Further details can be obtained from the Chief Dairy Officer.

THE PREPARATION AND HANDLING OF THE STARTER.

Starter Room.—A special room should be provided for the sole purpose of preparing and propagating the starter. This is an essential requirement in a factory and even in a farm cheese dairy handling a small quantity of milk, a special place should be provided for preparing and keeping the starter. The cultures should not be handled or kept in any room where cheese is made or stored, otherwise they are liable to become contaminated. The starter room should be properly enclosed and shut off from the rest of the building and should have a cement floor, efficient drainage and adequate ventilation. The walls should be finished in such a way as to prevent any mould growth. The starter room should also be equipped with the necessary facilities for heating and cooling the milk for starter making and for sterilising the starter utensils.

Milk for Starter Making.—Milk for starter making should be of the best possible quality. It should be free from objectionable flavours and odours and should be produced under the cleanest conditions. Many factories find it advantageous to induce one of their suppliers to produce special milk for starter making; a premium above the ordinary is paid for this milk in the production of which special care is exercised. It is generally recognised that to obtain the best results the milk for starter making should be free from any abnormality and should preferably have a high total solids content. Milk from sick animals or from diseased udders or from cows suffering from mastitis is not suitable for starter making.

As a rule it is best to use mixed milk from several cows for starter making rather than the milk from one specially selected cow—as is sometimes the practice—for it occasionally

happens that the apparently normal milk of a single cow has for some reason or other a weakening or restraining effect on the starter organisms. The cheese-maker should select the milk for starter making by means of the Fermentation and Methylene Blue Tests.

Utensils and Equipment for Starter Making.—Proper equipment is necessary for successful starter making. The actual equipment needed depends on the quantity of starter required. Factories handling large quantities of milk and which have to prepare up to 20 gallons of starter daily will obviously require somewhat more elaborate equipment than a small cheese dairy which uses less than a gallon of starter per day.

In the average cheese factory where large quantities of starter are prepared and handled every day it is almost impossible to avoid a certain amount of contamination, and for this reason many cheese-makers now make a practice of preparing and propagating a small quantity of starter in addition to the ordinary bulk quantity in the cheese making process.

This small quantity of stater is usually known as the "Mother Culture" or "Mother Starter." The actual cultivation of the mother culture and the ordinary bulk starter is exactly the same in principle; it is merely the quantity involved which varies. The mother culture is used for propagating the bulk starter. In the absence of mother cultures the bulk starter is propagated by inoculation from the previous bulk starter.

The maintenance of mother cultures, although it entails extra work, reduces to a considerable extent the risk of contamination ot the starter. For this reason the propagation of mother cultures is strongly advocated in all factories or dairies in which any considerable quantity of starter is used. It must be emphasised, however, that a good mother starter can only be maintained by exercising the same care and taking the same precautions as would be observed in handling the culture in a bacteriological laboratory.

The following method is recommended for preparing and propagating the mother starter.

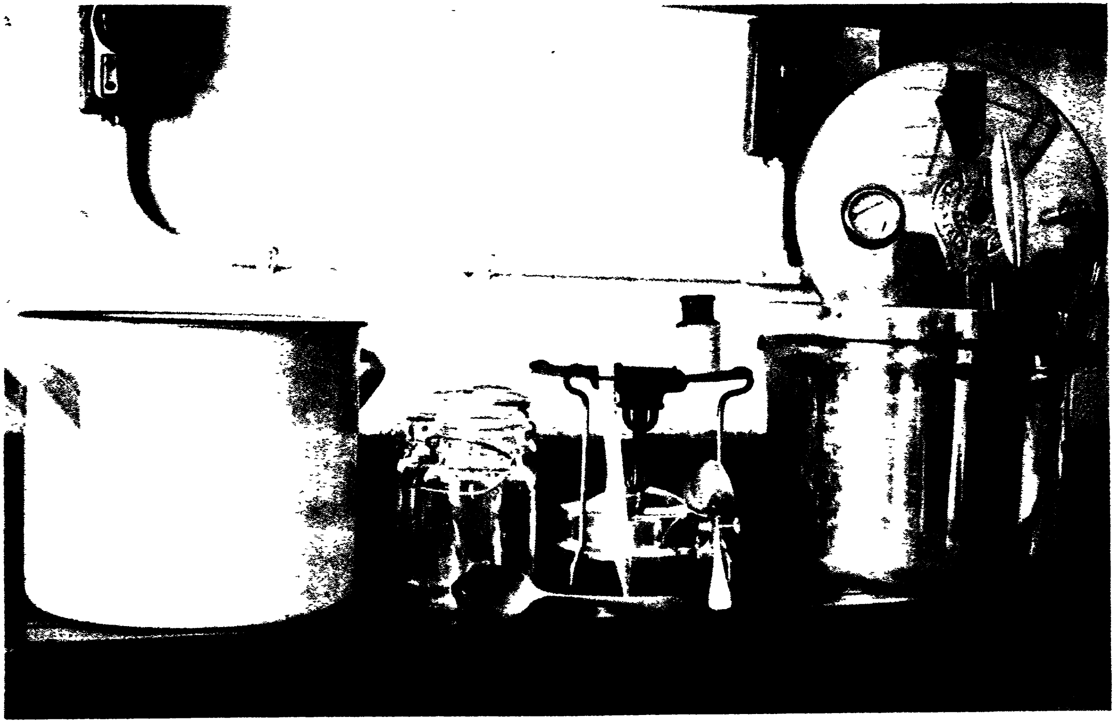


Fig 3 —Apparatus required for preparation of Mother Culture—Primus stove, spring-top jars 2 table spoons, thermometer, pressure cooker and receptacle for holding cold water.

Preparation of the Mother Starter.

Equipment Required.

1. A small pressure cooker with pressure gauge and blow off valve capable of holding at least two spring top fruit jars of one quart or three pint size. (See illustration in Figure No. 3.)

2. A water. jacketted incubator with a thermostat for keeping the temperature of the mother starter constant. An insulated box in which the temperature can be regulated by means of ice, cold or warm water will also act as an incubator for ripening the mother culture. Failing these a charcoal cooler may be used, although it is not a very satisfactory alternative.

3. A Primus stove.

4. Thermometer.

5. Half a dozen spring top fruit jars—quart or three pint size. Other types of bottles may be used such as ordinary milk bottles, etc. Bottles with metal or screw tops should not be used.

6. A couple of table spoons.

Preparing the Mother Starter.

1. The milk selected for starter making is placed in two spring top fruit jars, the jars having been filled about two-thirds full. The two jars of milk are then placed in the pressure cooker and heated over a Primus stove —or electric hot plate where power is available—for 10 or 15 minutes at a pressure of 15 lbs. The milk is then considered to be sterile. The two jars of milk are then left in the cooker until the milk has cooled down to 70°-75° F., or alternatively the jars are left in the cooker until cool enough to handle, when they are removed and cooled down to a temperature of 70°-75° F. by standing them in a receptacle containing cold water or through which cold water is circulating. Care must be exercised in cooling down the sterilised milk so as to avoid cracking the jars.

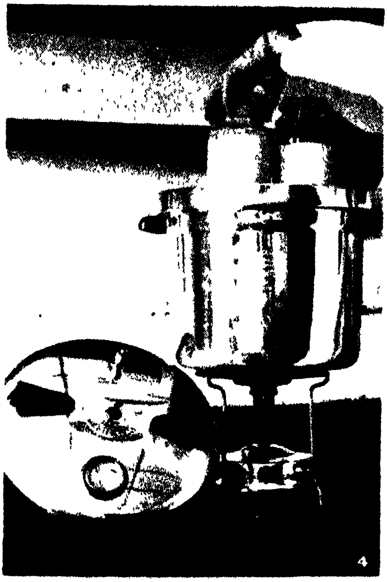
The temperature of the milk is gauged from the temperature of the water in which the jars are standing. When the temperature of the cooling water remains at 70°-75° F. the milk should be ready for inoculation. The thermometer should not be placed in the jars to determine the temperature, as this will only contaminate the sterilised milk.

2. When the milk has been cooled down to 70°-75° F. the liquid or powdered culture previously mentioned should be added to the two jars, half the culture being added to each jar. Before adding the culture care should be taken to sterilise the mouth and rim of the culture bottle by first wiping it with a piece of clean cotton wool saturated in methylated spirits and then holding it in a small open flame for a few seconds. The jars containing the inoculated milk are then placed in an incubator or insulated box and kept at a temperature of *70°-75° F. until the milk coagulates. As a rule the milk will have coagulated by the following day.

3. The following day a small portion of the coagulated milk in the first two jars is transferred by means of a clean sterile spoon to two more jars of milk which have been sterilised and cooled down as described. In making the transfer or inoculation great care must be exercised to avoid contamination of the cultures. The spoons used for inoculation must be perfectly clean and should be sterilised over an open flame immediately before use.

When transferring the coagulated culture the latter should be stirred with the sterilised spoon and a portion then quickly transferred to the freshly sterilised milk. A separace spoon should be used for each jar of coagulated culture, *i.e.*, if there are two jars of culture to be transferred, then two spoons will be required. Half a tablespoonful of the coagulated culture is usually sufficient inoculation for two pints of sterilised milk. The two jars of freshly sterilised and

*Powdered cultures are usually added to the sterilised milk at a temperature of 85°-86° F. and kept at this temperature until coagulation takes place; thereafter the culture is inoculated and incubated at 70°-75° F.



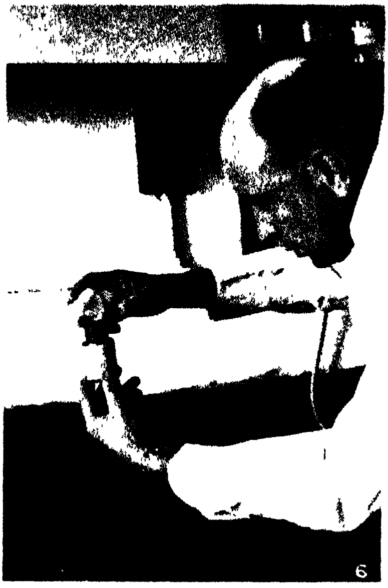
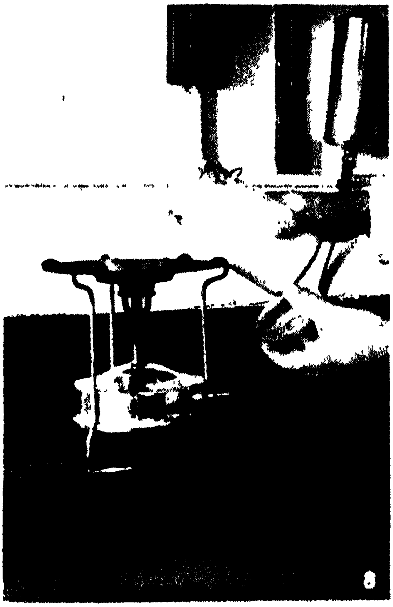


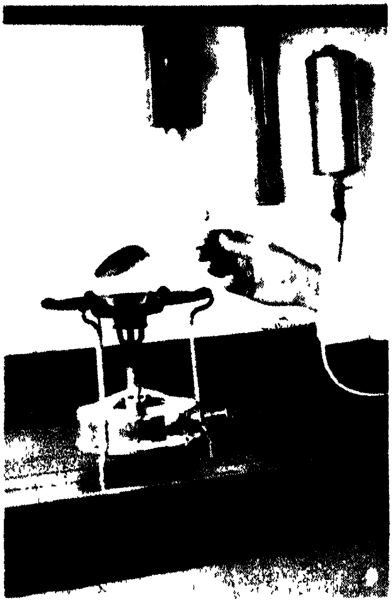
Fig 4.—Placing the two jars of milk for the Mother Culture in the pressure cooker where they are heated for 10 to 15 minutes at 15lb. pressure

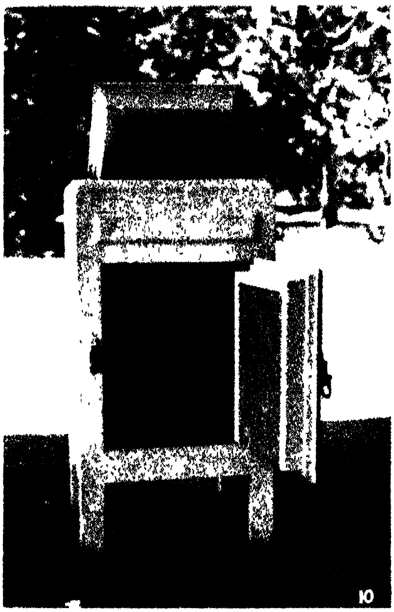
Fig. 5.—Placing the two jars of sterilised milk in cold water to cool down to 70-75° F

Fig 6.—Wiping the mouth and rim of the culture bottle with a piece of clean cotton wool soaked in methylated spirits.

Fig. 7.—Sterilising the mouth and rim of culture bottle by holding in an open flame. The culture is then poured into the jars of sterilised milk.







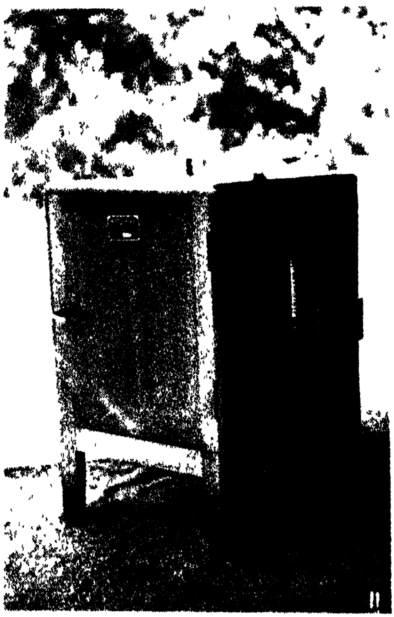


Fig. 8.—Before adding Mother Culture to bulk starter sterilise mouth and rim of jar by holding in an open flame.

Fig. 9.—Method of sterilising spoon used for inoculating Mother Culture.

Fig. 10.—Small insulated ice chest for incubating Mother Starters.

Fig. 11.—Electrically heated incubator with temperature control device for incubating Mother Starters.

inoculated milk are then placed in the incubator or insulated box and kept at a temperature of 70°-75° F. until they coagulate, when the contents are in their turn inoculated into sterilised milk and so on, this procedure being repeated every day.

After the coagulated cultures have been transferred they are shaken and examined and the best culture is then used for inoculation of the bulk starter.

In the absence of a steam pressure cooker the milk used in the preparation of the mother starter should be sterilised by intermittent heating, i.e., the milk should be heated to 195°-200° F. for about one hour on three successive days before it is inoculated with the starter culture.

For heating purposes a tin or metal box is required: This should be fitted with a false bottom. A four gallon petrol or paraffin tin can be converted for the purpose. (See figure No. 12.) The procedure is as follows: The two spring top jars containing the milk are placed in the metal box which should contain sufficient water to reach the level of the milk in the jars. The box is placed over a Primus stove and the water brought to the boil and kept boiling for at least an hour. The jars are then removed and allowed to cool down of their own accord in order to encourage the development of any organisms which may have survived heating. These jars are marked "A." The following day these two jars are heated again together with two new jars of milk marked "B." On the third day the two jars marked "A" are heated for the third time together with the two jars marked "B," which are heated for the second time and two new jars marked "C." After the third heating the two jars "A" which may now be considered sterile are cooled down to 70°-75° F. and inoculated with the liquid or powdered culture and incubated as already described. On the fourth day the jars "B" are heated for the third time together with the jars marked "C," which are now heated for the second time and two new jars of milk marked "D" which are heated for the first time. The jars "B," after being heated, are cooled down to 70°-75° F. and inoculated from the coagulated cultures in the jars marked "A." This process is repeated daily with the result that

every day two jars of milk which have been heated three times are ready for inoculation. If proper care is exercised this method gives very satisfactory results.

After the coagulated mother cultures have been inoculated into the freshly sterilised milk they are examined and the best culture is selected for inoculation of the bulk starter. The mother starters are examined for general appearance, body and texture, flavour and aroma and acidity. In general appearance the starter should show a solid smooth coagulation, free from gas-holes. A culture showing signs of gas should be discarded. Free whey at the surface of the culture is not usually objectionable. The texture should be smooth and free from lumps and the body should have a creamy, velvety appearance. Cultures showing signs of ropiness should be discarded. The culture should have a clean, pleasant, mild acid flavour and aroma; cultures showing pronounced coarse flavours or odours should not be used. The acidity of the culture may vary between .6%-.8%; higher acidities are liable to cause the starter bacteria to lose vitality. A dull, white appearance in the starter usually indicates excessive acidity. The acidity of the starter is determined by means of the acidimeter previously mentioned, a small quantity of the culture being removed from the jar for this purpose with a sterile spoon. The 9 cc. pipette used in this test should not be inserted into the culture in the jar or bottle, as this will contaminate the mother starter. It is important also to remember that the examination and selection of the mother starter should always take place after—and not before —these cultures have been transferred to fresh bottles of sterile milk; otherwise the mother cultures are liable to become contaminated.

In selecting the mother cultures, however, the cheese-maker should remember that the main function of a cheese starter is the vigorous production of acid throughout the cheese-making process and unfortunately the examination of a ripe culture by taste, smell or acidity tests does not necessarily give any indication as to the starter's acid producing potentialities in the cheese vat. Cultures which are identical in taste, aroma and acidity may yet behave very differently in the vat, the one being far more active and vigorous than the other.

For this reason it is recommended that the mother cultures should be tested regularly for vitality—in fact, the daily testing of the mother cultures for vitality is strongly advocated whenever possible.

The vitality test recommended is that perfected by Whitehead and Cox. The principle of the test, which is described hereunder, is to stimulate the cheese-making process and to compare the relative amounts of acidity produced by the different starters.

Vitality Test for Starters.

Equipment Required—

1. A wide mouthed bottle for each starter to be tested. The bottle should have a capacity of $1\frac{1}{2}$ pints and should have a tight fitting lid. A fruit jar will serve the purpose.

2. A water bath or incubator for holding the jars and contents at a constant temperature.

3. A 5 cc. pipette or a 1 cc. pipette.

4. An acidimeter or burette, etc., for determining acidity.

Method.—It is assumed that three starters are to be tested. 1 pint of milk, heated to 145° F. for 30 minutes and then cooled to 100° F. is poured into each of three clean, sterile jars. The milk used may be taken from the ordinary factory supply. The jars must be filled from the one lot of milk.

5 cc. of mother starter is added to the milk in each of the three jars, a different mother starter being used in each jar. The starter should be well stirred or shaken before taking the 5 cc. sample. The pipette must be washed with boiling water before use and after the measurement of each starter. Each jar is labelled with a mark or letter corresponding with the starter used. The contents of the jars are well mixed by shaking and the jars are then placed in the water bath at 100° F., the level of the water being adjusted so that its depth is equal to that of the milk in the jars.

After $\frac{1}{2}$ hour, 1 cc. of rennet is added to each jar of milk and well mixed by closing the jars and inverting them once

or twice. The jars are returned to the water bath and are left undisturbed for an hour to allow coagulation to take place. Then the curds are cut with a clean sterile knife, as evenly as possible, into pieces ¼ inch square and left in the water bath for a further 2 hours, after which time the whey is drained from the curd as completely as possible. The curds are incubated in the bath for two hours longer when the whey is again drained off and is tested for acidity by the method elsewhere described.

The curds are again incubated for 1 hour and whey once more tested for acidity. This is the final reading. From the two readings obtained with each sample it is possible to determine the relative activities of the three starters. The following are typical readings for "slow" or "fast" starters.

	Acidity (% Lactic Acid).		
	Starter A.	Starter B.	Starter C.
First reading	.18	.30	.31
Second reading.....	.25	.62	.57
Difference (increase in acidity)	.07	.32	.26

The results indicate that Start "A" is slow and very much less active than either "B" or "C."

The value of this test lies in the fact that it enables the cheese-maker to distinguish between active and inactive starters. The test is comparative between the starters tested on any one occasion, and for this reason it is essential that the contents of the different jars should receive exactly the same treatment, particular attention being paid to the cutting of the curd and draining of the whey.

After the mother starters have been examined, the selected culture is inoculated into the milk which has been prepared for the bulk starter. If the bulk starter is not ready for inoculation then the selected mother culture should be placed in an ice-chest, refrigerator, or other suitable cold place until required; it should not be left to stand at room temperature and so develop excessive acidity which may weaken the starter bacteria and render the culture sluggish.

Preparation of the Bulk Starter.—To obtain satisfactory results in preparing and handling the bulk starter, it is essential that all apparatus, stirrers, strainers, cans, buckets, etc., which come into contact with the starter should be properly cleaned and sterilised. Sterilisation may be effected, for all practical purposes, by boiling all apparatus for half an hour or by sterilising by steam in a steam chest at a temperature of at least 200° F. for 30-40 minutes. It is surprising how few factories are provided with the necessary facilities for this purpose. A small steaming chest or cabinet in which the starter utensils and cans can be kept and steamed can be provided at very little cost. An ordinary dustbin fitted with a false bottom and a steam jet through which steam can enter from a boiler makes an excellent sterilising chest for a small factory or dairy.

The equipment needed for the preparation of the bulk starter depends on the quantity of starter required. For factories in which considerable quantities of starter have to be prepared a special starter vat or apparatus such as that illustrated in Figs. 13 and 14 would be advisable. Smaller quantities may be prepared either in a starter can of the type illustrated in Fig. 15 or in a small enamel or stainless steel pail. The best materials for the starter vats or cans are stainless steel, aluminium, enamelled-ware and glass. Of these stainless steel is considered to be the best.

Whatever type of container is used it should have a smooth, seamless surface, which can be easily cleaned and sterilised. Rusty or battered cans should not be used.

As previously mentioned, milk for starter marking should be selected by means of the fermentation and Methylene Blue test. The best milk is not too good for starter making. For the bulk starter the use of whole milk is generally advocated in preference to separated milk for the reason that whole milk usually receives less handling than separated milk, and this means fewer opportunities for contamination. The milk which is used for preparing the bulk starter is heated in one or other of the containers already described to a temperature of 190° F-200° F. for at least one hour and is then cooled down to 70°-75° F., when it is inoculated from the mother culture.

The actual heating of the milk for the bulk starter may be carried out in various ways. A common method is to place the starter cans containing the bulk milk in a water bath consisting of a petrol drum, oil drum or tight wooden barrel cut in half and into which steam is discharged from a steam pipe or hose. The steam heats up the water in the drum and and so raises the temperature of the milk in the starter cans. Smaller quantities can be heated in an enamel or seamless pail standing in a cut petrol tin or other receptacle placed on the kitchen stove or over a Primus heater (see Fig. ??). As a general rule heating for one hour at 195° F.-200° F. should be sufficient sterilisation. If, however, the milk is of doubtful quality, then it is recommenced that it should be heated as described on two successive days, *i.e.*, at 190° F.-200° F. for one hour. The starter cans or containers should be provided with metal covers fitted with a lip which overlaps the rim of the can. Such covers prevent loss of heat and contamination of the starter from the air or from splashes of water from the drum or water bath. Cloths should not be used for covering starter cans. During heating and cooling the milk should be stirred, and for this purpose a stirrer of the plunger type should be used. A separate stirrer, so arranged as to pass through the lid of the can, should be provided for each starter can.

During the heating and cooling of the milk for the bulk starter, thermometers should be used for taking the temperature of the water in the drum and of the milk in the starter can. The thermometer used for taking the temperature of the water in the drum should not be used for taking the temperature of the milk; a separate thermometer should be used for the latter purpose and may be suspended in the milk by means of a piece of wire hooked over the rim of the can or passing through the lid.

After being heated to 190° F.-200° F. for one hour the milk is cooled down to 70° F.-75° F. by means of ice or by circulating cold water through the water bath or drum. The milk is then ready to be inoculated with the previously selected mother starter.

Experience has shown that the best results are obtained by a fairly heavy inoculation of the bulk milk and a rapid

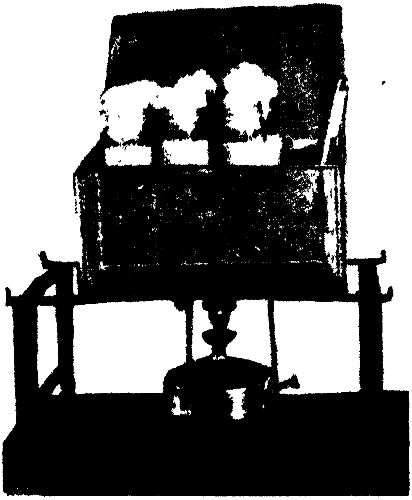


Fig 12—Improvised apparatus for intermittent heating of milk for Mother Cultures (Bulletin No 133, Union of S Africa)

Fig 14—A suitable type of vat for heating, cooling and holding the milk starter (with acknowledgment to D & F Kusel & Co, Wisconsin, U S A.)

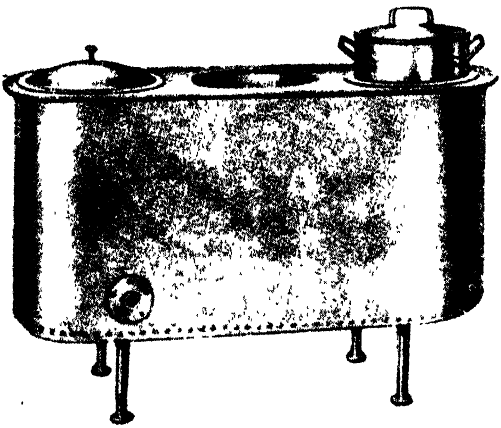


Fig 13.—A suitable type of starter apparatus for small factories. (Bulletin No. 133, Union of S. Africa).

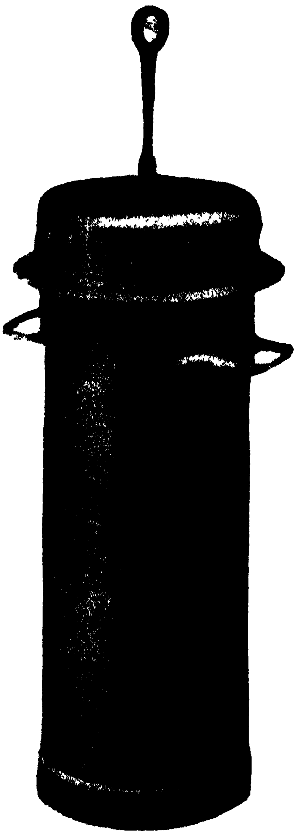


Fig. 15.—A Starter Can with plunger and cover.

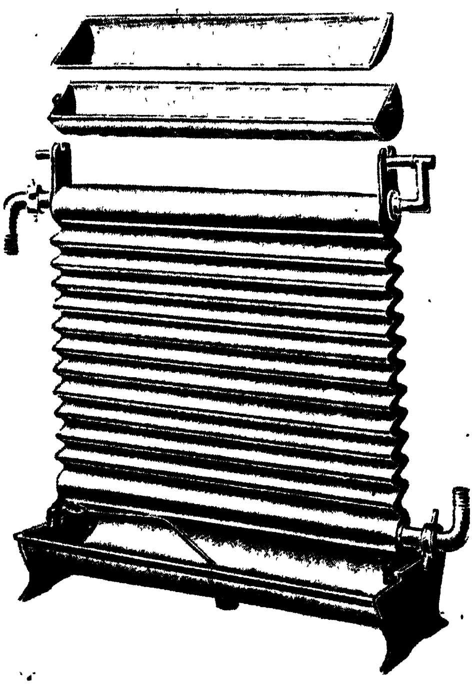


Fig. 16.—Milk Cooler.

coagulation of the starter in preference to a light inoculation and a slow coagulation. One quart of mother culture should be a sufficient inoculation for 10-12 gallons of milk, *i.e.*, about a 2% inoculation. The milk is inoculated late in the afternoon, or preferably in the evening, and thereafter held at a temperature of 70°-75° F. until the following morning, when it should have coagulated and be ready for use. In practice this procedure has given very satisfactory results.

It is important that the bulk starter, after inoculation, should be kept or incubated at a temperature within the range of 70°-75° F., as the lactic acid producing bacteria in the starter can compete most favourably at these temperatures with other types of organisms that may be present. At higher temperatures the starter may ripen too quickly and become over acid or undesirable heat resistant types of bacteria may develop, whilst at lower temperatures the growth of the starter bacteria may be seriously delayed. Every effort should be made to ripen or incubate the bulk starter at a constant temperature within the range indicated. This, however, is a precaution which is all too frequently overlooked or ignored with corresponding unsatisfactory results in the working of the starter in the cheese vat.

The acidity of the bulk starter when ready for use usually varies from .65 to .80. Opinions differ as to the best acidity, but most authorities agree that excess acidity is not necessary or desirable in the starter. Coagulation usually takes place at an acidity of .55%. An acidity of .85 may be regarded as the maximum degree of acidity to which the starter should be ripened. If acidity is developed in excess of this figure then the starter bacteria are liable to lose vitality. According to some authorities a starter which has been ripened at 72° F. contains the greatest number of living active bacteria when its acidity is about .6 to .7%. Cheese-makers are advised, therefore, to aim at an acidity of .65 to .7%, as this has been found in practice to give satisfactory results. If the starter ripens too quickly and if the acidity is always high then it is advisable to use a lower incubation temperature. The starter should have a smooth creamy consistency.

In dairies or factories where a mother starter is not used the portion of the bulk starter which is used for setting the

starter for the following day should be placed in a clean, sterilised receptacle fitted with a lid and set aside in the coolest available place. It should not be allowed to stand about in the hot air of the factory or dairy for several hours before being inoculated into the next day's starter. Unfortunately this is a common practice and then cheese-makers wonder why their starters deteriorate or loose vitality.

FAILURE OF THE STARTER.

Most cheese-makers experience failures with their starters from time to time. Usually the first indication of trouble is slow development of acidity in the cheese vat followed in some cases by the complete collapse of the starter which ultimately will not coagulate. In this Colony slow starters seem to be most commonly caused either by (*a*) the use of abnormal milk, or (*b*) by continual over-ripening of the starter.

1. **Abnormal Milk.**—It is generally recognised that abnormal milk is not suitable for starter making. Mention has already been made of the fact that milk from diseased udders is not suitable for cheese making or for starter propagation. Cases have been reported where as little as one pint of milk coming from one bad quarter of a single cow was sufficient to prevent acid development in milk from a herd of fifty cows. It is also claimed that cows grazing on young spring grass produce milk which inhibits the growth of starter organisms. Most authorities agree that milk of high total solid content and high natural acidity is best for starter making, trouble being more frequently experienced with starters prepared from milk which is deficient in solids.

Excessively slow development of acidity in the cheese vat has also been shown to be due to the presence of so-called "non-acid" milk which has been found to contain certain organisms capable of producing a substance antagonistic to and which actually retards the growth of the ordinary starter bacteria. Heating the milk up to boiling point does not destroy the inhibitory substance. The trouble usually occurs during the warmer months of the year, and apparently the only method by which it can be checked is by cooling the milk to a low temperature. If the trouble is suspected, then the milk of the various suppliers should be tested. For this

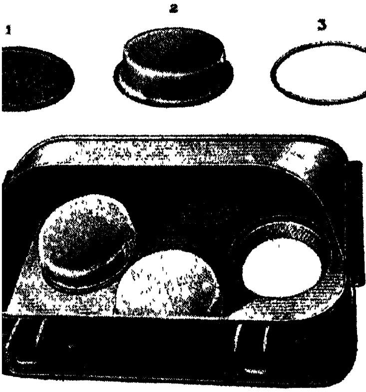


Fig. 17.—Milk strainer and filters.

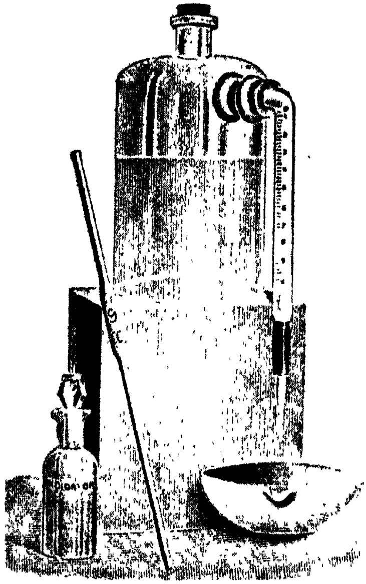


Fig. 19 —Acidimeter, showing burette for N/10 caustic soda solution, porcelain testing dish, 9cc. pipette and bottle containing indicator (Phenolphthalein)

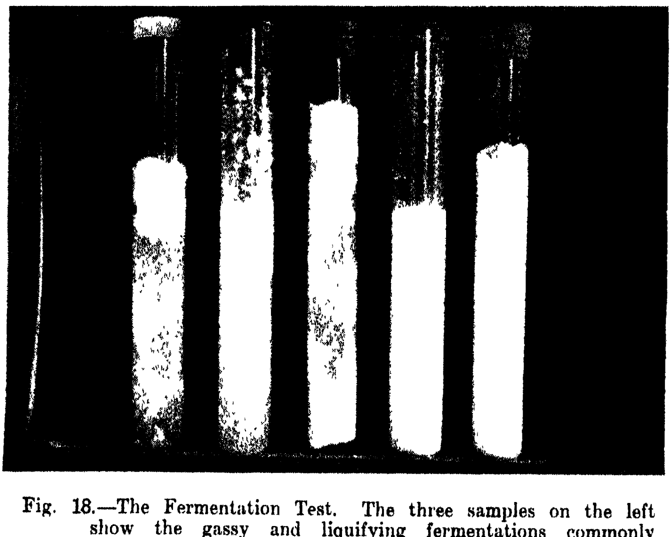


Fig. 18.—The Fermentation Test. The three samples on the left show the gassy and liquifying fermentations commonly associated with unhygienic methods of milk production. The two samples on the right show the clean solid coagulation usually found in milk produced under clean conditions.

purpose a modification of the Vitality Test for starters is used. Samples of milk from the various suppliers are heated to 150° F. for a few minutes in a water bath and are then cooled down to 100° F. and 5 cc. of the *same* starter added to each sample. Thereafter the procedure is exactly the same as in the Vitality Test. If all the milk samples are normal the acidity of the whey from each should be more or less the same (*i.e.*, within .1% lactic acid. Samples giving markedly lower readings can be regarded with suspicion, as it is probable that those particular milks are retarding the development of acidity in the vat.

2. **Continual over-ripening of the Starter.**--This is probably the most common cause of slow starters in this Colony. As previously stated, a starter usually contains the largest number of living, active lactic acid producing bacteria when its acidity is about .6 to .7%. At higher acidities these organisms become weakened and commence to die off, those which survive being mostly slow growing acid tolerant strains. Continual over-ripening, therefore, tends to increase the number of slow growing bacteria present and produces a slow starter.

Over ripening is commonly caused by holding or incubating the starter at too high a temperature or for too long a period. In practice, therefore, slow starters can usually be avoided by fairly heavy inoculation and a short ripening period (10-12 hours) at a temperature of 70°-75° F. Slow starters, or starters which are apparently dead, may often be revived by keeping them cool and by repeated heavy inoculations.

(*To be continued.*)

Rhodesian Milk Records.

SEMI-OFFICIAL.

COMPLETED LACTATIONS.

Name of Cow	Breed.	Milk in lbs.	B Fat in llbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Jill	Friesland x Devon	5661.60	239.86	4.23	300	N. G. Barrett, Gavenny, Rusape.
Bags	G Friesland	5150.40	206.97	4.02	203	J. A, Baxter, Glen Norah, P.O Box 1040, Salisbury.
Bud	G. Friesland	9353.80	325.64	3.48	300	
Christmas	G Friesland	6824.20	243.54	3.57	262	
Clacupar Penappollo	P B Friesland	5776.20	202.02	3.50	300	
Dam	G Friesland	5964.00	224.85	3.77	262	
Donga	G Friesland	6167.80	203.34	3.29	300	
Edwin	G Friesland	10286.60	312.65	3.04	300	
Juta	G. Friesland	7413.00	248.71	3.36	300	
Light	G Friesland	7448.60	246.05	3.33	300	
Longone	G. Friesland	7395.20	213.59	2.89	300	
Member	G Friesland	7388.70	272.86	3.69	300	
Mofat	G Friesland	9198.10	350.55	3.81	300	
Monkey	G Friesland	8676.70	278.30	3.09	300	
Mount Darwin	G. Friesland	7240.50	234.03	3.23	300	
Muller	G. Friesland	6707.80	238.58	3.56	300*	
Oranges	G Friesland	7936.40	271.51	3.42	300	
Shoriwa	G Friesland	6207.90	208.32	3.35	271	
Short	G Friesland	5453.10	208.08	3.82	282	
Siman	G Friesland	6934.30	228.65	3.30	309	
Skofman	G Friesland	6520.30	251.99	3.86	300	
Steamer	G Friesland	6708.20	274 76	4.10	300	
Whisky	G Friesland	6449.00	233.21	3.62	271	
White III.	G Friesland	6154.50	202.17	3.28	300	
Blossom	G Friesland	4880.40	204.92	4.20	300	J. R. Bedford, Poltimore, Marandellas.
Dorothy	G.S. Devon	5244 90	214.54	4.09	268	
Betty	G. Friesland	5513.50	213.46	3.87	300	Boyd Clark Est, Castle Zonga, Inyazura
Brandy I.	G. Friesland	5882.00	232.07	3.95	265	
Catherine I.	G. Friesland	6037.50	245.28	4.06	300	
Catherine III.	G Friesland	6172.50	212.59	3.44	300	
Favourite	G. Friesland	6687.00	269.08	4.02	300	
Star	G Friesland	5949.00	201.12	3.38	300	
True Girl II.	G Friesland	6201.00	236.36	3.81	300	

SEMI-OFFICIAL.—(Continued).

Name of Cow.	Breed.	Milk in lbs.	B. Fat in lbs	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Chick	G. Friesland	7399.00	270 84	3.66	300	Lieut.-Col. E. W. Brighten, Castle Base, Rusape.
Gambol	G. Friesland	5916.40	247.45	4.18	300	
Ophelia	G Shorthorn	5390.20	249.91	4.64	300	
Zonia	G. Friesland	6378.60	206.36	3.24	300	
Morag	G Red Poll	5439.00	267.67	4.92	300	K. M. Campbell, Hedon Farm, Marandellas.
Polly	G. Red Poll	5096.00	201.15	3 95	300	
No. 130	G. Friesland	4921.00	200.50	4.07	300	Coldstream Dairy, P.O. Headlands.
No. 131	G. Friesland	4742.00	207.22	4.37	300	
No. 250	G. Friesland	5724.50	217.98	3.81	279	
No. 252	G Friesland	5570.00	237.74	4.27	300	
No. 290	G. Friesland	7360.00	294.06	4.00	300	
No. 295	G. Friesland	7196 00	258 23	3.59	300	
No. 299	G. Friesland	6480.00	200.06	3.09	300	
Ann	G. Friesland	5500.80	209.54	3.81	264	T. Cousins, Oaklands, Gwelo.
Blanco	G Friesland	6215.50	276.93	4.46	250	
Patience	G. Friesland	5752.20	220.40	3 83	300	
Fun	G. Friesland	6968.80	248.02	3.56	300	Hon H. V. Gibbs, Bonisa, Redbank
Girl	G. Friesland	7268.80	286 20	3.94	300	
Grace	G. Friesland	9133.80	291.99	3.20	300	
Rosalind	G. Friesland	6672.50	268.38	4 02	300	
Christmas	G Friesland	6071.20	220.05	3.62	240	E. B. Goldsworthy, Gowerhill Dairy, P O. Box 1143, Salisbury.
Larkhill Red Bird	G. Red Poll	4824 60	204.92	4.25	242	A H MacIlwaine, Larkhill, Marandellas.
Larkhill Rosalie	G. Red Poll	5977.50	209.41	3.50	300	
Biddy	G Friesland	6279 50	272.95	4 35	300	F. H R. Maunsell, Forres, P.O. Bromley
Annetta I.	P.B. Friesland	10226.50	359 33	3 51	300	W S Mitchell, Springs Farm, Iron Mine Hill.
Annetta II.	P.B. Friesland	8773.50	310.68	3.54	300	
Annetta III.	P B. Friesland	7566.00	279.99	3.71	290	
Annetta III.A.	P B Friesland	6666.50	257.83	3.86	300	
Annetta III.B.	P B. Friesland	6109.00	217.50	3.56	260	
Erin Go Braghanne	P.B. Friesland	5909.00	215.75	3.65	284	
Sheep Run Dignity "B"	P.B. Friesland	6904.00	298.10	4 31	300	
Sheep Run Dignity "C"	P.B. Friesland	7123.50	258.59	3 63	275	
Sheep Run Lady	P.B Friesland	9146.50	363.42	3.97	300	

RHODESIAN MILK RECORDS.

SEMI-OFFICIAL.—(Continued).

Name of Cow.	Breed.	Milk in lbs.	B. Fat in lbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Black Eyed Susan	G. Friesland ...	5544.10	211.99	3.82	300	Com. W. M. Nash, Chakadenga, Marandellas.
Doody	G. Friesland	4345 30	200.25	4.61	276	
Doris	G. Friesland	4955 90	229 75	4 63	300	
Flora	G. Friesland	5589.40	250.86	4.49	300	
Grace	G Friesland	5672.50	222 68	3.93	300	
Tulip	G Friesland	5229 40	266.86	5.10	300	
Jessie	G. Friesland	7350.80	314 62	4.28	300	Red Valley Estate, Lushington, Marandellas.
Jkundwa	G. Friesland	6234.00	224.91	3.63	300	
M'Jaidza II.	G. Friesland	6860.00	289.70	4.22	300	
Salt III.	G. Friesland	6554.20	228.74	3.49	300	
Posy Pike	G. Friesland	9390.20	382.76	4 08	300	Red Valley Estate "P" Herd, Lushington, Marandellas.
No. 59	G. Ayrshire	5557.90	201.98	3 63	290	Rhodes Matopo Estate, P.B. 19K, Bulawayo.
No. 62	G Ayrshire	5533.30	218.10	3 94	300	
No. 66	G. Friesland	5310.30	207.57	3.90	300	
Chicongiwe...	G Friesland	5607.80	230.37	4.11	300	W. F. H. Scutt, Maple Leaf, Norton.
Whinburn Bounty	G Friesland	6724.70	213.61	3.18	300	Major R. R Sharp, Whinburn, Redbank.
Whinburn Frivolity... ...	App. Friesland	6561.40	215 24	3 28	300	
Whinburn Greengage ...	App. Friesland	5103 60	208.14	4 08	274	
Whinburn Moth	P.B. Friesland... ...	5544.40	202.61	3.65	300	
Whinburn Princess... ...	P.B. Friesland... ...	5343.10	207.44	3.88	293	
No. 104	G. Friesland	9530.50	354.22	3.72	300	A. Stokes, Safago, Gwelo.
No. 120	G. Friesland	10344.80	371.52	3.59	300	
No. 174	G. Friesland	8898.80	306.55	3 45	300	
Betsy	G. Friesland	8770.00	338.89	3.86	300	W. E. Tongue, North Lynn, Bulawayo
Kitty	G Friesland	8704.00	273.01	3 14	300	
Kuku	G. Friesland	8887.00	315.02	3 54	300	
Yeo	G Friesland	9575.00	339.66	3.55	300	
Bawdsey Pear	P.B. Red Poll	5263.60	214.10	4.07	269	A. M. Tredgold, P.B. 61Y., Bulawayo.
No T.B.9	G. Red Poll	6499 20	268.35	4.13	300	
Mint's' Blossom's Delight of Rynheath	P.B. Guernsey	4164 00	209 29	5.17	300	A. F. H. Valentine, Battery Spruit, Umtali.
Mischief	G. Friesland	4710 00	211.29	4.49	300	

SEMI-OFFICIAL.—(Continued).

Name of Cow.	Breed.	Milk in lbs.	B. Fat in lbs	Average % B. Fat.	No. of Days	Name and Address of Owner.
Bluffhill Barbara	P.B. Friesland	7540.60	317.82	4 21	300	Bluffhill Dairy P O. Box 346, Salisbury
Bluffhill Bunty	P.B. Friesland	9206.90	309.67	3.36	300	
Rabbit	G Friesland	7529.20	260.00	3.45	300	
No 39	G Friesland	8044.30	228.52	2.84	300	
Crescent	G. Friesland	5232.10	231.86	4 43	221	T. Cousins, Oaklands, Gwelo
Mabeka	G Friesland	4731 00	204.85	4.33	300	
Prunella	G. Friesland	5837.30	249.93	4.28	300	
Sally	G Friesland	4788.20	202.88	4 24	300	
Spot	G Friesland	5670.80	274.93	4.85	261	
Wendy	G. Friesland	5312.70	214.60	4.04	300	
No. A. 14	G Friesland	6725.60	206.24	3.07	300	H. A. Day, Stoneridge, P.O. Box 1153, Salisbury.
No A. 90	G Friesland	5358.60	225.60	4.21	265	
No 49	G Red Poll	8239.30	280.50	3.40	300	
No. 55	G. Friesland	5184 80	208.27	4.02	283	
No. 64	G Friesland	5012.90	207.68	4 14	262	
No 82	G. Friesland	5251.50	215.35	4.10	300	
No 84	G Ayrshire	4393.50	213.30	4 86	279	
No 124	G. Friesland	5524 90	225.87	4.09	300	
No. 14	G. Shorthorn	5114.00	222.64	4 35	300	M. V. Fitzgerald, Chieftain, Iron Mine Hill.
Contract II.	G. Friesland	6296.10	244.05	3.88	300	P. Freeland, Lingfield, Gwelo
Kanda II.	G Friesland	5883 50	234 38	3 98	256	
Rosebud	G. Friesland	6241 30	233.80	3 75	300	
Silver	G Friesland	6012.00	203.99	3 39	300	
White II.	G Friesland	7392.50	250.37	3 39	300	
No 11	G Friesland	5333.50	210.69	3.95	300	
No. 14	G Friesland	4621.70	214.04	4 63	300	
Connie II.	G. Friesland	6625 00	273.40	4 13	300	W. D Haywood, Ordoff Farm, Gatooma.
Cynite	G Friesland	7035.00	282.59	4.02	300	
Nancy	G Friesland	5692.80	284.67	5.00	300	
Snow	G Friesland	6109.00	227.21	3.72	300	
Sidea	G Friesland	6495.60	233 09	3 59	300	Mrs. M. Huxham, Spitzkop, Mazoe.
Clover	G Friesland	6108 50	225.79	3.69	268	V A Lawrence, Knockmaroon, Norton
No 23	G Friesland	7691.00	265.46	3.45	300	Mazoe Citrus Est, P.O. Mazoe
No 37	G Friesland	7278.00	212.30	2.92	300	
No 40	G Friesland	7113 00	219 09	3.08	300	

RHODESIAN MILK RECORDS.

SEMI-OFFICIAL.—(Continued).

Name of Cow. Breed.	Breed.	Milk in lbs.	B. Fat in llbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Susan	G Friesland	5078.00	227.36	4.48	255	Com. E. L. Morant, Marirangwe, P.O. Box 741, Salisbury.
Dobbie	G Friesland	9272.00	286.19	3.09	300	F. B. Morrisby, Sunnyside, Gwelo.
No 5	G Friesland	6067.00	225.06	3.71	300	
No 15	G Friesland	5699.00	217.04	3.24	300	
No. 20	G. Friesland	6523.0)	240.24	3.68	300	
No 26	G. Friesland	6821.00	221.49	3.25	300	
No. 27	App. Friesland	8799.00	283.44	3.22	300	
No. 28	G. Friesland	6142.00	221.07	3.60	300	
No. 30	G. Friesland	5911.00	206.00	3.49	300	
No. 47	G. Friesland	5717.00	205.15	3.59	300	
No. 58	G Friesland	6480.00	256.62	3.96	300	
No. 60	G Friesland	6263.00	220.81	3.53	234	
No. 64	G. Friesland	5357.00	212.64	3.97	300	
No. 78	G. Friesland	5698.00	211.56	3.71	300	
Mary III.	G. Friesland	7154.60	347.63	4 86	279	Red Valley Estate, Lushington, Marandellas.
Pancake	G. Friesland	4787.80	205.10	4.07	271	Red Valley Est. "P" Herd, Lushington, Marandellas.
"P" Elegance	G. Friesland	5737.50	202.17	3.52	300	
"P" Outspan	G. Friesland	5611.30	225.37	4.02	300	
Darwin	G. Friesland	5173.40	263.87	5.11	282	W. F. H. Scott, Maple Leaf Farm, Norton.
Mgode III.	G. Friesland	8701.30	327.95	3.77	300	
Natalie	G. Friesland	7511.60	232.06	3.09	300	
Orpia	G Friesland	6687.30	240.21	3.59	274	
Scones	G. Friesland	7871.70	266.62	3.39	270	
Blackie	G. Friesland	7365.00	264.17	3.59	300	W .Sole, Bauhinia, Glendale
Dinah	G. Friesland	6190.90	235.48	3 80	300	
Joyce	G. Friesland	11412.00	452.81	3 97	300	
Patience...	G. Friesland	5819.90	204.63	3.52	300	
Rose	G Friesland	10388.49	362.74	3 49	300	
Susan	G Friesland	9804 00	345.81	3.52	300	
Bertha	G Friesland	6233.00	227.83	3.65	297	Union and Rhod. M. and F. Co., Ltd., Quinnington, Salisbury.
Bonny	G Friesland	6374.00	305.48	4.85	291	

OFFICIAL.

Name of Cow. Breed.	Breed.	Milk in lbs.	B. Fat in llbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Matopo Drinkstone Missie II., born 20.9.1930...	Red Poll	6274.10	236.42	3.75	283	Rhodes Matopo Estate, P.B. 19K., Bulawayo.

Sales

Agricultural Experimental Station, Salisbury.

KUDZU VINE CROWNS.

Delivery during January and February, per 100 crowns 15/-.

SWEET POTATOES.

Cuttings :

Delivery during January and February, 6/- per bag.

Varieties: Virovsky, Early Butter, Linslade, Calabash Leaf.

GRASS ROOTS.

Delivery during January and February, 6/- per bag.

Varieties: Woolly Finger, Swamp Couch, Creeping False Paspalum, Naivasha Star and Panicum Makarikari in limited quantities only.

All the above will be delivered free by rail to any station or siding in Southern Rhodesia, but the price does not include road motor service charges. Cheques should be made payable to the Department of Agriculture, and preliminary enquiries and subsequent orders should be addressed to the Agricul turist, Department of Agriculture, Salisbury.

Cash must accompany orders.

Southern Rhodesia Veterinary Report.

NOVEMBER, 1940.

DISEASES.

African Coast Fever was diagnosed at Katsambi's kraal, in the Mondoro Native Reserve, in the Hartley native district.

TUBERCULIN TEST.

Thirty-four bulls and forty-two cows were tested upon importation. Of these three bulls reacted to the test, and were destroyed.

MALLEIN TEST.

One horse was tested, with negative results.

IMPORTATIONS.

From Union of South Africa.—Bulls, 31; cows, 42; horses, 1; sheep, 1,433; pigs, 1.

From Bechuanaland. Protectorate.—Sheep, 245; goats, 27; pigs, 82.

EXPORTATIONS.

To Northern Rhodesia.—Bulls, 2; cows, 10.

To Portuguese East Africa.—Slaughter cattle, 120.

To Nyasaland.—Bulls, 3.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom. Beef quarters (chilled quality), 3,650; tongues, 4,182 lbs.; livers, 11,324 lbs.; tails, 4,158 lbs.

To Northern Rhodesia.—Beef carcases, 145; pork carcases, 20; veal carcases, 3; offal, 6,922 lbs.

To Belgian Congo.—Beef carcases, 67; pork carcases, 90; veal carcases, 11; offal, 888 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa.—Corned beef, 404,604 lbs.; beef fat, 100 lbs.; tongues, 1,140 lbs.; sausages, 501 lbs.; tin stew, 672 lbs.

To Northern Rhodesia.—Meat meal, 1,000 lbs.

To Belgian Congo.—Meat meal, 1,600 lbs.

To United Kingdom.—Meat extract, 20,091 lbs.; beef powder, 5,383 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-40.

Monthly Report No. 96. November, 1940.

Red Locust (*Nomadacris septemfasciata*, Serv.).—Winged swarms were reported from eleven (11) districts during November, namely, Lomagundi, Darwin, Mazoe, Salisbury, Hartley, Charter, Selukwe, Victoria, Melsetter, Chibi and Gwanda.

It may be noted that the swarms reported were confined to the eastern half of the Colony.

Most of these swarms were described as "very large" and as "very dense."

Dissection of specimens recorded at Salisbury has not so far revealed any appreciable development of the ovaries and breeding colouration has not yet appeared.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

Vol. XXXVIII.] No. 2 [February, 1941

Editorial

Notes and Comments

A League of Husbandry.

An article appeared in a recent issue of the London *Sunday Times* which may be of historic importance. It was written by Viscount Lymington, once Chairman of the Navy League, and it advocates the founding of a League of Husbandry. "Under this heading," he says, "can be gathered all that is most valuable in national life. Primarily it must be concerned with the soil as a basis of production, but it must cover all the interests of primary producers who are bread-winners and consumers alike." The belief that the consumer is a separate species whose hand is against all producers is a convenient commercial legend that should be killed forever. The real cleavage is stated to be, not between town and country, but between producer and parasite. The parasite must become the servant and not the master of the producer. The distributer of the soil's products which Britain eats, gets five times as great a reward per head as the producer, and the writer says "Neither the soil, nor the producer can stand this strain indefinitely." All problems of agriculture, of policy and of commercialism come eventually back to the soil, the preservation of which should dictate policy. In Viscount Lymington's words: "Purpose makes policy. Policy can be summed up in one phrase—health for the soil. Upon it everything depends. To dogmatise unashamedly: without a soil made healthy and fertile there will be no health in crop, beast or man. We are reaping the rewards of raping

the fertility of the soil in all non-peasant countries. Hence we have dust-bowls and floods abroad, clogged drains, derelict fields and rough grazings at home. . . . Healthy soil means balanced farming, balanced farming means that all necessities for healthy living are produced locally: it means therefore a self-sufficiency in all but a few large cities, and healthy diet for the townsman."

To attain the ends which he has enumerated the writer recommends small yeoman farms, the ruralisation of many industries, and the dependence of land tenure on the responsibilities rather than the privileges of ownership. Essential features are the return of town wastes to the soils, the restoration of rural life, and the revision of values in education. "The need is to awaken the dormant instinct of the townsman, already stirring under bombardment, quickening his sense of the fool's purgatory in which he has lived for a generation."

Some of Lord Lymington's words are notable. This is a part of his conclusion: "A League of Husbandry will not be mushroomed overnight, but will come from the gathering of scattered leaders with insight for the townsman, who can formulate policies and give hope, as much by their incorruptible example as their native philosophy and knowledge of the soil. The old matted turf of commercialism, dead to everything but its own sleepy struggle for comfort, is already rough ploughed by the mechanics of Mars; it only awaits the cultivator and the sower."

Seed Maize Association.

Two years and more of encouragement, demonstration and propaganda by the Agricultural Department culminated on December 5th at a meeting called by the Rhodesia Agricultural Union, in the formation of a Seed Maize Association. The deterioration in the quality of the maize crop during the last few years has been due in part to the poorness of the maize used for seed by many farmers. The seed produced by reputable growers has been inadequate to supply the country, and the general lowering of the standard has made the large-scale production of good seed uneconomic.

The new Association should do much to stop the deterioration and to restore quality and yield. It brings the Colony into line with maize producing countries in other parts of the world, while in one respect—field-selected maize—it marks a new departure in Southern Africa. This is seed selected from suitable plants growing in normal competition in the seed plot which is isolated from other maize.

The other category—"A Quality Seed"—is seed selected from individually examined ears.

In respect of each bag of seed passed by the Inspector the Secretary of the Association will issue a certificate showing (1) the grower's name and full address, (2) the name of the variety, (3) the class of seed, (4) germination percentage, (5) percentage of disease infection, (6) this certificate shall also bear the signature of the grower and that of the Inspector, (7) number of years seed has been field-selected, in respect of Field Selected Maize.

The formation of this Association, together with that of the Seed Wheat Association recently formed, marks a big step forward in Rhodesian agriculture.

Kikuyu.

Two articles on Kikuyu grass (*Pennisetum clandestinum*) appear in the New Zealand Journal of Agriculture for November. This grass, which is a native of Kenya was, according to P. S. Syme, introduced into New Zealand about 1919, and in Auckland Province at all events, is no longer welcome. On loose fertile soil Kikuyu spreads with alarming rapidity, and once firmly established is very difficult to eradicate. It has been found in New Zealand that Kikuyu introduced to a rye-clover sward quickly suppressed the clover, and then lacking nitrogen, itself formed a stemmy sod-bound mat of runners of inferior feeding value. Joints of the runners were moved by the feet of cows to other fertile lands and spread with devastating rapidity, choking out clovers, and ruining the existing pasture. The grass, according to the same writer, requires a very fertile or loose soil for its best growth. In respect of its growth on loose soil and its drought resisting

qualities, both he and J. E. Bell, in another article, find much to commend Kikuyu, which was found to have a very definite value for covering slips, checking erosion on hill country, and in binding sand dunes. On land which is not agricultural, on sandy wastes which are threatening to drift and cover good agricultural land, Kikuyu has proved of the very greatest value, in conjunction with marram grass and lupins.

Kudzu.

The kudzu, which was fully described in the July issue of the Journal, is assuming growing importance in Australia although, according to the Queensland Agricultural Journal, not very extensive trials have been made. American experience is entirely in its favour. Since the beginning of erosion control in America, 40,000 acres have been planted with this crop, mostly in the South-Eastern States. Everywhere it has earned a high reputation as a fodder crop and as a soil-binder.

It is not seriously affected by drought, it grows rapidly, it restores fertility to the soil by adding nitrogen and organic matter, and it maintains a stand over long periods without yearly soil preparation and planting. It grows vigorously on eroded land when once established, and its dense cover protects the soil from beating rain. Not only is kudzu specially suited for the reclamation of badly eroded slopes, but it also produces a palatable hay and forage of excellent quality with a high feeding value.

Growth Promoting Substances.

Increasing prominence is being given in agricultural and trade papers to growth promoting substances which have been somewhat in eclipse since the early and fantastic claims made on their behalf were found to be without scientific foundation. The qualities and powers which were credited to them would undoubtedly have revolutionised agricultural practice had they in fact existed. They would have doubled yield, eliminated disease, and made the selection of seed and the striving for improved strains unnecessary. Recent pains-

taking work, particularly by the United States Department of Agriculture, has done much to clear the air, though a recent paper in the News Edition of the American Chemical Society stresses the fact that present knowledge of the effect of growth promoting substances on the growth, development and behaviour of plants is meagre and only just developing.

Six of the chief growth substances were recently extensively tested on several different kinds of plants. They were applied to the roots by irrigation, to the leaves and stems by sprays, to special parts when mixed with lanolin as a paste, and to the seeds by dusting, using a mixture of talc powder. Under the conditions of the experiment the substances failed in every case to promote the total growth, advance the date of flowering or increase the yield.

Certain substances did, however, result in specific localised responses, some of which are likely to be of practical value. In one case fibres of the stem were greatly thickened, an effect which might be used in the production of linen or other commercial fibres. A dilute solution sprayed on apple trees effectively prevented fruit drop. The development of fruits, including tomato, squash and lemon, was induced without pollination. Root formation was brought about in cuttings; this property has been used commercially for some time.

There is little doubt that in time other responses will be found which will prove of practical commercial value.

The substances tested were indoleacetic, naphthaleneacetic, indolebutyric and indolepropionic acids, indoleacetamide and naphthaleneacetamide.

Grain Fumigation and Storage.

The following note is submitted by the Division of Entomology:—

Since the present war began, the price of carbon bisulphide, used by many farmers and produce merchants for killing insects in grain and beans, has been about doubled. Methyl bromide is a gas which, in the march of progress, is likely to take the place of carbon bisulphide and some other

fumigants. (There is no progress without change). The newer gas is more effective, and could be imported profitably at considerably less cost per fumigation unit than the older. It has been referred to in this Journal several times previously, notably in the issue of September, 1940, pp. 527-8.

The penetrating qualities of methyl bromide necessitate the use of better coverings to enclose stacks than the tarpaulins often used to confine the fumes of carbon bisulphide. Rubberised sheets are excellent but are too expensive for occasional use. Bulk storage of grain in feinforced brick bins is a happy, modern and progressive solution to the problem. Such bins can be built cheaply inside a shed, paying for themselves in a very few years in the saving of bags alone. In addition, there is a direct saving in grain by reduced insect and rodent attack. Furthermore, the necessity to fumigate is greatly lessened, but when fumigation does become necessary or desirable, the advantages of methyl bromide can be utilised.

Bins should be strongly and properly constructed, for bulk grain behaves in some respects rather like water. Plans for the construction of suitable bins are obtainable from the Irrigation Department. The question of bulk storage is discussed from the entomological point of view in Bulletin No. 1161, obtainable at 3d. per copy from the Editor. The same Bulletin includes some notes on methyl bromide.

Whilst a combination of bulk storage and fumigation might appear to meet all entomological requirements of maize storage, the advantages of cleanliness should not be overlooked. Bulk storage in itself is an aid to cleanliness, and the combination may reduce the number of fumigations needed, or even eliminate them. In this connection we would remind readers of a note which appeared in the September Journal to the effect that the final paragraph to an article on fumigation in an official London publication reads: "Cleanliness, segregation of goods, etc., remain the foundation of pest control."—*Cleanliness Aids Insect Control.*

A Warning to Potato Growers

THIS IS WHAT IS HAPPENING IN NEW SOUTH WALES.

"Owing to the very dry conditions experienced last summer, the amount of certified potato seed available has been much less than normal. Partly because of this shortage and partly because of the high prices for certified seed many potato growers in coastal districts have planted uncertified seed. In consequence virus diseases, particularly leaf roll, have been very prevalent and yields have been, or are likely to be, very light. Much of the uncertified seed used came from other States, and, though often very attractive in appearance, has produced such a high percentage of virus-affected plants that many growers have decided that, in future, certified seed is the only seed worth while planting. It should be emphasised that the appearance of the tubers is usually of no assistance whatever in deciding whether the tubers are free from virus diseases such as leaf roll and mosaic, although the presence of diseases such as scab, Rhizoctonia and eelworm, can be detected by an examination of the tubers. In the case of virus diseases, the only really reliable method is to know that the tubers were harvested from healthy plants.

"An indication of the increasingly-wide recognition of the value of certified potato seed is the fact that it is now obtainable from certain Sydney seed firms."—(Extract from *The Agricultural Gazette of New South Wales*, Vol. LI., Part II., Nov. 1, 1940.)

The Dairying Industry

STATEMENT BY THE DAIRY INDUSTRY CONTROL BOARD.

1. During the past twelve months the dairy industry in this Colony has been the object of considerable criticism and it has frequently been asserted that owing to the enforcement of the farm butter licensing system and dairy legislation generally, the dairying industry was not making progress, production of dairy produce was on the decline and farmers were being forced to abandon dairying in favour of beef production. In support of these assertions attention has been drawn to the import figures for dairy produce and the recent falling off in the production of butter.

Whilst it may be true that a certain number of farmers have discontinued dairying operations, the percentage of producers who have been forced out of the dairying business as a result of the legislative measures referred to is negligible. There can be but little doubt that the real reason in most cases has been the improved prices obtainable for slaughter stock which have induced many farmers—mainly dairy ranchers—to stop milking their cows. From the point of view of the dairying industry this is an entirely satisfactory development. Far too large a percentage of the Colony's production has in the past been derived from cows which were not of dairy type and which were not in the first instance intended for milking purposes. As a result, production has been spasmodic and has fluctuated according to the nature of the season, the prices obtainable for beef cattle and the attractiveness of other forms of farming. The industry has thus been characterised by a lack of stability as well as by the production of excessive quantities of inferior, low grade produce which has invariably been dumped on the market early in the season.

The object of the dairy legislation now in force is to eradicate these undesirable features from the industry and

to place the industry in a position from which it can grow healthily to meet local needs and perhaps develop to a stage where export will become possible. Admittedly there is room for expansion in the industry, but it is the aim of all who have the best interests of the industry at heart to avoid any indiscriminate increase in production and to ensure that such increase as may take place will be derived from *bona fide* dairy or dual purpose herds.

2. **Production and Importation of Dairy Produce.**—In order to form some idea as to the state of the dairy industry in the Colony it is necessary to examine the Territory's production in relation to its consumption of dairy produce. In examining the Colony's output of dairy produce it is obviously necessary that all forms of dairy production should be taken into account. It is clear, for instance, that any sudden increase in the consumption of fresh milk might conceivably be effected at the expense of supplies which would otherwise be sent to creameries and factories for conversion into butter and cheese. It is not possible, therefore, to form a true picture of the industry's progress, or lack of progress, by mere reference to the production of one particular commodity such as butter.

According to figures supplied by the Department of Statistics the total dairy production for the Colony, expressed as gallons of milk, during the past 10 years has been as follows:—

Year.	Total output of milk in S.R.
1930	6,100,000
1931	6,000,000
1932	6,100,000
1933	5,800,000
1934	5,400,000
1935	5,700,000
1936	6,500,000
1937	6,000,000
1938	5,400,000
1939	5,700,000

It will be noted that during the years 1938 and 1939 there was an appreciable decline in dairy production. There is little doubt that the main reasons for this decrease in output were (*a*) the rainfall conditions which during the seasons 1937/38 and 1938/39 were distinctly unfavourable for dairying; and (*b*) the improved prices obtainable for slaughter and breeding cattle. Many farmers and small ranchers who in the past, in order to make ends meet were compelled to milk cows, primarily of beef type and sell the cream or butter to obtain a monthly cheque, were now able to dispense with this undesirable expedient.

Figures are not yet available to show the total dairy production of the Colony for the year 1940, but there is little doubt that this will constitute a record.

At a conservative estimate the fresh milk trade, owing mainly to the establishment of Air Training Centres in the Colony, has absorbed during the current year, an additional 200,000 gallons of milk.

The butter production (farm and creamery) is significantly ahead of last year's output, and will probably account for the best part of a further 1,000,000 gallons of milk. The production of creamery butter during the dairying season 1939/40 amounted to 1,368,922 lbs., which is approximately 50% higher than the output for the previous season. This actually is a record for the Colony, for although it is true that the production of creamery butter approximated 1,500,000 lbs. in 1931/32, almost one-sixth of this total, or approximately 250,000 lbs., represented butter manufactured from cream imported from the Bechuanaland Protectorate.

On the basis of the figures quoted it is predicted that the total milk production for the Territory for the current year of 1940 will be in the vicinity of 7,000,000 gallons, and will thus exceed that of any previous year.

Notwithstanding the considerable increase which has taken place in the production of dairy products during the season which has just ended, a certain quantity of dairy produce had to be imported into the Colony. This importation has been made necessary owing to the astonishing

increase which has recently taken place in the local consumption of all dairy produce, particularly creamery butter. This is illustrated by the following figures:—

Local Consumption of Creamery Butter.

Year.	Creamery Butter—lbs.
1933/34	815,587
1934/35	793,694
1935/36	879,411
1936/37	901,263
1937/38	1,062,000
1938/39	1,352,265
1939/40 approx.	1,500,000

It is apparent, therefore, that within a period of seven years the local consumption of creamery butter has been almost doubled.

During the season 1939/40 the Colony exported approximately 175,000 lbs. of creamery butter to markets in adjoining territories, whilst imports during the same period amounted to approximately 193,000 lbs. A more or less similar state of affairs has prevailed in regard to cheese.

It is apparent, therefore, that despite a greatly increased domestic consumption the Colony has manufactured during the season which has just ended almost sufficient dairy produce for its own requirements.

3. **Farm Butter Licences.**—There appears to be a considerable amount of misapprehension concerning the so-called restrictions on the manufacture of farm butter, and the criticisms directed against this measure usually take the form of assertions to the effect that the farm butter licensing system is forcing farmers out of dairy production or is otherwise restricting manufacture and that the removal of the restrictions would have the effect of augmenting supplies of butter in the Colony to such an extent as to obviate the need for import.

With regard to the first contention, *i.e.*, that the restrictions are forcing producers out of production, there can be little doubt but that they are having just the opposite effect. If the restrictions were removed the local market would be flooded with inferior butter during the early part of the rainy season and this butter, the bulk of which is sold at 6d. to 1s. per lb., would on account of its cheapness practically push creamery butter off the market. This has always happened in the past until the restrictions were imposed, and would happen again. It is obvious that under such conditions it would be virtually impossible to maintain the price of creamery butter at the level of the past two years. The price would have to be dropped if the creameries were to retain a share of the trade in the local market, and this must inevitably be accompanied by a reduction of the price which the creameries would be able to pay for butter-fat. While, therefore, the removal of the restrictions might be to the advantage of a limited number of farmers who make farm butter, it would be greatly to the disadvantage of the much larger number of regular dairy farmers—of whom there are over a thousand—who send cream to the creamery. Under the Act and present regulations the legitimate dairy farmer can now specialise in his business, and is doing so in a way which has never been possible before. Furthermore, to many farmers dairying is increasingly becoming their main source of income, and this will continue as long as the farmer can obtain a satisfactory price for his produce.

If, as the result of the removal of the restrictions on farm butter making, the price of butter-fat were to be reduced to the low level of previous years, then there would be less inducement for producers to continue their dairying operations and many of them would undoubtedly turn their attention to other forms of farming. Ultimately, therefore, the abolition of farm butter licences and consequent unrestricted farm butter making would have the effect of seriously curtailing the production of dairy produce in the Colony.

With regard to the contention that the removal of the restrictions would augment production and obviate the need for import, it is necessary to point out first of all that the

farm butter licensing system in effect does not in any way restrict the manufacture of butter.

In the first place, producers who are so situated that they are unable to send cream to a creamery are, under the terms of the Dairy Act, entitled to licences without limitation, whilst there is nothing to prevent producers who have been refused a licence or who are limited to the manufacture of a certain quantity of farm butter, from sending their cream or surplus cream to the factories, where it can be converted into creamery butter.

In some cases the relaxation of the restrictions on farm butter making would probably lead to diminution in the quantity of butter available for the local market, *e.g.*, a considerable quantity of farm butter has for many years past not been consumed as butter on account of its inferior quality but has been utilised only for conversion into ghee. This butter-fat is at present being sent to the creamery, where it is usefully converted into butter of quite reasonable quality.

It should be remembered also that farm butter cannot be kept for any length of time or conserved in cold storage, and further that the bulk of it is made and marketed during the early part of the dairying season and that during this period creamery butter is in large part forced off the market and has consequently to be stored. Storage results in high costs and in deterioration, which in the past has frequently resulted in the Colony having to import first grade butter later in the season while at the same time it was exporting the lower grades. The removal of the restrictions on farm butter making, whilst it might result in a material increase in the quantity of butter manufactured during the early part of the season, would not in any way obviate the necessity which might arise for import of first grade butter later in the year.

The relaxation of these restrictions, therefore, whilst not materially reducing the necessity for import or appreciably augmenting local supplies, would simply prejudice the interests of over a 1,000 farmers who at present send cream to a creamery and who may be regarded as the very backbone of the dairying industry.

In conclusion, it must be emphasised that the policy of the Dairy Industry Control Board, which is empowered under the Act to fix the prices of dairy produce, is not to establish artificial price levels, but to maintain a steady price that will enable the dairyman to go steadily ahead in the production of milk or butter-fat. The Board gives an assurance that, unless exceptional circumstances forces a change in policy, the present seasonal range of prices will be maintained for a period of three years. The Board hesitates to give an assurance in respect of a longer period than three years because of the difficult world conditions, but producers should appreciate that the Board exists for the purpose of maintaining prices at a remunerative level. With this assurance it is now up to the farmer to see that he makes ample provision to feed his stock. Dairy stock needs careful study to give the best return, and the good dairyman will score on present-day prices. He will study his herd, feed his cows and make full provision for feeding and end up the year with foodstuffs in hand, rather than run the risk of finding his concentrates running short and having to cut down feed of bean hay and silage. November and December are the months when dairy cows require the most individual attention.

Where the dairyman is concerned, it is a mistaken idea to think there are certain months in which he need not feed. If he makes provision to feed the whole year round, his cheque will more than compensate him for his trouble.

Cleanliness Aids Insect Control.

The Farm Home

Uses of Honey for Sugar

Honey is a super-saturated solution of sugars, and as such may be satisfactorily used to replace other sugars in cooking, canning or preserving, provided certain general rules are followed. Honey and sugar differ in that sugar is a sweet containing no moisture or acid, while honey consists of different kinds of sugars in solution with water and contains a small amount of acid, explains C. B. Gooderham, Dominion Apiarist. Perhaps the chief advantage of substituting honey for sugar in cooking is that the final product will remain moist for a much longer time than if sugar alone is used. Bread, cakes, cookies and other comestibles in which honey is used in place of sugar will keep moist for long periods of time without any deterioration of flavour; in fact, the flavour will usually improve with storage.

Honey may replace all sugar in cases where the amount of sweetening material is small, such as in muffins and bread. The following rules are based on experimental work that has been done at the Central Experimental Farm, Ottawa, with honey in cooked foods, and by following these rules any recipe may be adapted for the use of honey .

1. Measure honey always in the liquid form. If it is granulated heat over warm water until it is liquid. 2. For every cup of honey used, reduce the liquid called for in the recipe by one-fifth. 3. One cup of honey is as great in sweetening power as one cup of sugar. 4. Use $\frac{1}{4}$ to $\frac{1}{2}$ teaspoon of soda to each cup of honey. 5. Increase the amount of salt by $\frac{1}{8}$ to $\frac{1}{4}$ teaspoon. 6. When substituting honey for sugar in cake, reduce the liquid in the recipe by one-fifth and use half honey and half sugar. Fruit cake is an exception to this rule and all honey may be used. 7. In milk puddings, pie fillings, and such like, add the honey with the thickening agent, *e.g.*, flour or corn starch.

It should also be remembered that honey from different sources varies greatly in flavour. Generally speaking, the lighter the colour the milder is its flavour.

Experiments have also been conducted with satisfactory results on the use of honey in canning. In the manufacture of ice-cream, honey may be used in the place of sugar, and in addition the honey will impart a flavour of its own, so that no other flavouring need be used.—Press Note, Dominion Department of Agriculture, Canada.

Agricultural Cleanliness,
Field Sanitation,
Agricultural Hygiene,
Phytosanitary Methods—
Call it what you like, but

CLEANLINESS AIDS INSECT CONTROL.

The Manufacture of Cheddar Cheese

By The Dairy Branch.

(*Continued.*)

THE CHEESE-MAKING PROCESS.

It is not possible to lay down any hard and fast rules for making cheddar cheese which could be applied to all parts of the Colony. Conditions in this Territory in regard to soil, pasture, rainfall, etc., vary to such an extent that any method or technique which might be regarded as sound practice in parts of Matabeleland might not produce equally as satisfactory results in parts of Mashonaland. Minor adjustments to the cheese making process have, therefore, to be introduced to meet the varying requirements of local conditions. At the same time it should be emphasised that the less the cheese-maker departs from the established principles of cheddar cheese making as laid down by the expert makers of old, the better.

1. **Receiving the Milk.**—In this Colony cheddar cheese is usually made from sweet milk, *i.e.*, morning's milk to which a starter is added. The use of evening's milk kept over until next morning is not advised, except in the months of May, June and July, when the coldness of the nights ensures good keeping qualities in the milk. (Evening's milk may, of course, be used at other seasons of the year if facilities in the form of artificial refrigeration are available for cooling the milk and keeping it cool.)

The evening's milk, if used, must be immediately cooled to a temperature of about 60° F. by running the milk over

a cooler of the type illustrated in Fig. 7. The following morning the cream which has gathered on the surface should be carefully skimmed off into a bucket, and mixed with the warm morning's milk. If the weather is cold the cream should first be heated to 100°-110° F. Milk delivered to factories is weighed on arrival and then conveyed from the milk receiving room along a tin conveyor through a strainer into the cheese vat. In some factories and dairies the cans of milk are carried into the making room by the natives delivering the milk. This is an objectionable practice, as these natives, who are not usually very clean, are invariably accompanied by flies. The natives who deliver the milk should not be allowed into the making room.

The milk should be strained into the vat through a proper milk strainer and not through cloths.

Ripening the Milk.—As mentioned elsewhere, a certain amount of acidity must be developed in the cheese making process so as to obtain the characteristic flavour, body and texture in the cheese. This acidity is developed in certain amounts at different stages, the first stage being the period which follows immediately after the milk is poured into the cheese vat. The development of acidity at this stage is referred to as "Ripening the Milk" and is brought about by the addition to the milk of a certain quantity of starter. The time allowed for ripening the milk will depend amongst other things on the initial acidity of the milk in the vat, the activity of the starter, the amount used and the time when it is added. In this Colony factory milk which may be an hour or longer on the road does not usually require much ripening. Cheese makers handling their own milk, however, may have to ripen the milk for one or two hours before adding the rennet. If mixed milk (night's and morning's) is used the milk may be ripe enough for rennetting half an hour to an hour after the starter has been added.

After the milk is placed in the vat the starter is added and the milk raised to a temperature of 85°-86° F. and allowed to ripen.

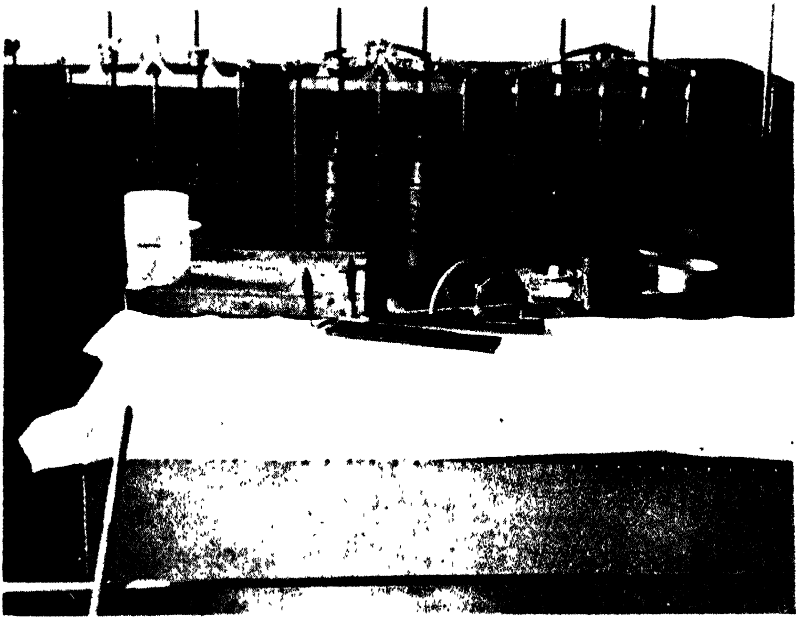


Fig 20.—The cheese-making room showing cheese vat, presses, curd knives, etc.

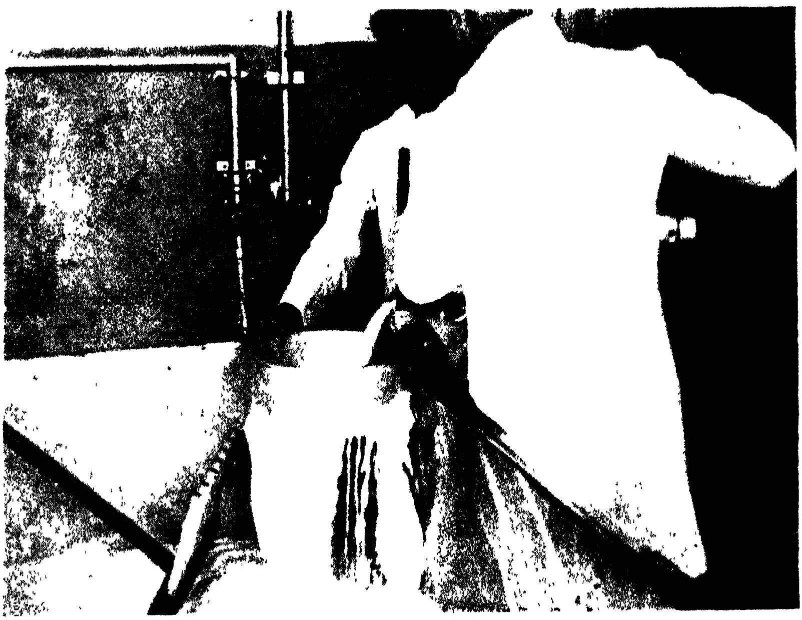


Fig 21.—Adding the bulk starter to the milk in the vat.

In some cases the starter, or portion thereof, is added to the first lot, or first few lots of milk, placed in the vat. This usually saves a certain amount of time and is quite a safe practice, provided that the subsequent supplies of milk are not likely to be unduly delayed.

The amount of starter to add varies according to the quality and acidity of the milk, the activity of the starter, the time it is added, the district and the season of the year. The amount to add can only be learned by experience, but the general rule is to add enough and no more to produce a normally working cheese. The cheese maker should bear in mind that the curd should be firm, dry and well cooked and show the proper amount of acidity in the whey about 3-3¼ hours after renetting. Any variation in this time usually indicates too little or too much starter. The amount of starter used by cheese makers in this Territory usually varies from ½% to 3%, *i.e.*, from half a gallon to three gallons per 100 gallons of milk. Milk of good quality requires very little starter; similarly only small amounts need be used when the starter is particularly vigorous or when it is added some considerable time before rennetting. Cheese makers handling their own milk and who can control the conditions under which it is produced should not find it necessary to use more than half a per cent. of starter. Larger amounts, however, are usually necessary when the starter is added shortly before rennetting or when handling factory milk of unsatisfactory bacterial quality. As a general rule it is better to use a small quantity of starter added to the milk some time before rennetting than to use a large quantity shortly before the rennet is added. The former method usually gives a more even ripening of the milk and a more regular development of acidity in the later stages of the process, whereas a large quantity of starter added just before rennetting generally results in a grainy, fast working curd and a coarse flavoured cheese.

During the winter months more starter is usually required than in summer and it is usually necessary also for the milk to be ripened to a higher degree of acidity before rennetting. During the months of September and October and November

when the milk is usually deficient in fat and solids, care must be exercised not to use too much starter or to develop excessive acidity, otherwise a hard, dry-bodied cheese will result.

For these reasons it is not possible, therefore, to lay down a hard and fast rule as to the amount of starter which should be used. Generally speaking, however, ½%, *i.e.*, 1 pint to 25 gallons of milk should be sufficient under conditions where the cheese maker is handling the milk from his own cows, whilst 1% to 2% should be ample for factory milk; the necessity for larger amounts of starter than these indicates bacterially defective milk due to faulty methods of production, in which case efforts should be made to improve the quality of the milk at its source rather than to attempt the correction of its faults at the factory or dairy.

The starter, before being added to the milk, should be thoroughly stirred to a smooth, creamy consistency and should be strained into the vat to remove any lumps or pieces of curd. If the starter is of the correct degree of acidity and has been incubated at the right temperature then its consistency should be such that it will readily pass through an ordinary milk strainer, especially if diluted with a few gallons of milk from the vat. If, however, the starter is too acid or has been held at too high a temperature, then it is almost certain to be thick and curdy, in which case it will only strain with difficulty. After adding the starter the milk should be well stirred and then heated as previously mentioned up to 85°-86° F.

Adding the Colouring.—Colouring matter, or Annatto, is usually added shortly before rennetting. The amount of annatto varies according to the depth of colour required. In Rhodesia the demand is for a medium straw colour, to produce which 1-2 ounces of colouring per 100 gallons of milk is usually sufficient, the smaller quantity being added when the cows are on green grass and the larger amount being added during the dry season when the cows are receiving little if any green colour producing feed.

Cheese intended for export to the British market must be either white (uncoloured) or else fairly highly coloured (2½-3 ounces of annatto per 100 gallons of milk).

The annatto is first diluted with four or five times its own volume of cold water and is then thoroughly stirred into the milk so as to ensure even mixing throughout the vat.

Colouring matter must always be added after and not before the starter so as to avoid the appearance of white specks in the cheese.

Adding of Rennet.—Rennet is added as soon as the milk is properly ripened, the acidity or ripeness of the milk being first ascertained by one or more of the acidity tests previously described, *i.e.*, the acidimeter test and either the Marshall Rennet or Monrad tests. It is not possible to lay down any hard and fast rule as to the ripeness or acidity that the milk should show when the rennet is added, as this will vary from one district to another and with the season of the year and the quality of the milk and the quantity of milk to be handled, etc. As a general rule, however, the milk should be ripe enough for rennetting when it shows an acidimeter test of .19 to .20 per cent., and either a Monrad test of 20-22 seconds or a Marshall rennet test of 4-5 spaces (summer test) or 6-7 spaces (winter test). Needless to say these figures should only be regarded as a rough guide. In some parts of the Colony the milk when freshly drawn has a natural acidity of .22 to .23 per cent., so that under these conditions the acidimeter test recommended above would obviously not apply. The cheese maker should bear in mind that the curd should be properly firmed up, without showing excess acidity, about 3-3¼ hours after rennetting. The temperature at which the milk is rennetted as well as the amount of rennet required will depend on the acidity, quality and quantity of the milk and the season of the year, etc. The usual temperature at which the rennet is added is 85°-86° F. Higher temperatures, however (88-90° F.) may be used with small quantities of milk or where difficulty is experienced in obtaining a firm or sufficiently rapid coagulation. Lower temperatures than those recommended give a slow coagulation and are not usually advisable.

Generally speaking, 5 ounces of rennet per 100 gallons of milk (1 dram to 2½ gallons of milk) is sufficient for ordinary use. Larger amounts, however, may have to be used for milk

produced in areas deficient in lime or phosphates. More rennet should be used also with over-ripe milk and milk of high fat content, or if the rennet is weak. The rennet, diluted with about 10 times its own bulk of cold water, should be poured evenly over the whole surface of the milk and then be well stirred into the milk for two minutes to ensure even distribution over the whole vat.

Care must be taken not to over-stir the milk otherwise a broken curd will result. After the rennet has been thoroughly mixed into the milk the surface of the milk should be agitated gently—with a thermometer—for a further 4 or 5 minutes to prevent the cream from rising. Surface stirring must be discontinued as soon as the milk begins to coagulate. The first sign of coagulation can be detected by (1) flicking the surface of the milk with a finger, bubbles will remain on the surface if thickening has commenced; (2) allowing a drop of water to fall on the surface of the milk; if coagulation has started the drop of water will retain its identity and make a small hole or depression on the surface of the milk. The vat should then be covered up with a clean cloth to prevent cooling at the surface and the milk left to coagulate.

Coagulation and Cutting the Curd.—Under ordinary circumstances coagulation should take place and the curd be ready for cutting in from 35 to 45 minutes. If coagulation takes longer than this then either more rennet should be used and/or the milk should be rennetted at a higher temperature.

The object of cutting the curd is to divide it up into small particles from which whey can be easily expelled. Experience and judgment is necessary to decide when the curd should be cut. If the curd is cut too soon considerable loss of fat may result, whilst if cut too late the curd will be too firm to permit of even cutting. The following tests are used to decide when the curd is ready to cut.

(1) Insert the index finger obliquely into the curd and raise it to the surface. If the curd splits cleanly over the finger and leaves a clear whey the curd is ready for cutting.

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Figs. 22 and 23.—Testing the firmness of the curd. When ready for cutting the curd will split cleanly over the finger or come away cleanly from the side of the vat.

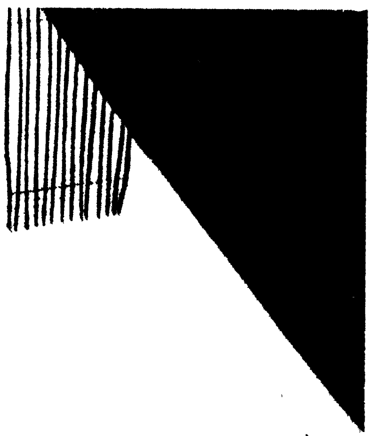

Fig. 24.—Cutting the curd lengthways with the vertical knife.

(2) Apply gentle pressure with the back of the hands and fingers on the surface of the curd close to the side of the vat; if the curd leaves the sides of the vat cleanly it is ready for cutting.

Specially constructed knives, both horizontal and vertical, are used for cutting the curd. Some cheese makers use the horizontal knife first, others the vertical. It does not really matter which knife is used first, as long as the necessary care is exercised in cutting. The vertical knife is entered in the curd in a slanting position, handle towards the holder, and is removed from the curd in exactly the opposite manner.

The horizontal knife should be entered in the curd and removed with a quarter circle motion. The curd is cut lengthways and crossways with each knife. When cutting with the vertical knife it should be lifted out each time it reaches the end of the vat; the horizontal knife may be turned round in the curd at each end of the vat. The knives should be drawn straight through the curd and should not overlap the portions previously cut. Cutting must be done as evenly as possible and care exercised to avoid bruising or injuring the curd. When properly cut the curd particles will be of uniform size and the whey of a pale greenish colour.

There is a tendency amongst cheese makers in this Territory to cut the curd into particles which are too large with the result that difficulty is frequently experienced in firming up and the curd particles are then liable to contain too much moisture when the whey is run off; except in one or two areas, it is usually advisable to cut the curd into small particles as this permits of a more rapid release of the whey. Two cuts with each knife are not usually sufficient. After cutting twice with each knife the portions of curd adhering to the sides and bottom of the vat should be carefully removed and mixed by hand with the contents of the vat. Cutting should then be continued with the vertical knife until the particles of curd are reduced to about the size of a small pea. The actual size to which the particles of curd should be cut, however, will depend on various factors, such as the quality and composition of the milk, season of the year, etc. The curd particles should be small enough to permit of satisfactory firming up within two hours after cutting.

Stirring and Heating the Curd.—After the curd has been cut the individual particles must be kept separate. This is achieved first by hand stirring for about ten minutes and then by stirring with a curd rake. The stirring must at first be done gently, otherwise there may be a considerable loss of fat. After the curd has been stirred a few minutes by hand the whey should be tested for acidity. It will be noted that the acidity of the whey at this stage is appreciably less than the acidity of the milk when rennetted, due to the absence of the casein of the milk which is now in the curd. In the case of normally working cheese the acidity of the whey will vary from .12 to .14 per cent. lactic acid. The acid test at this stage gives an indication as to how rapidly the acidity is likely to develop, *e.g.*, if the milk was rennetted at .20 per cent. acidity and the whey when tested after cutting showed an acidity of .14 or .15, then this would indicate that the acidity is developing rapidly and the cheese maker will have to arrange accordingly.

It will be noted also that after the curd is cut a film begins to form on the outside of each particle of curd; this film allows the whey to escape but prevents the release of fat and casein. Care must be taken that this film does not harden or firm too quickly and so prevent the escape of whey. The cheese maker's object now is to firm up and dry out the curd by the contraction and expulsion of whey from the individual particles. This is effected by heating and continued stirring of the curd aided by the further development of acidity. The heating process is commenced 10 to 15 minutes after cutting, very slowly at first and then more rapidly as the higher temperatures are reached. Heat is applied either by turning steam or by placing hot water in the jacket of the vat. Heating should take about 45 to 50 minutes, so that the maximum temperature is reached approximately one hour after cutting. Usually the temperature can be raised one degree every 4 minutes for the first 5 or 6 degrees, *i.e.*, from 85°-86° F. to 90°-92° F., and thereafter one degree every 2 or 3 minutes up to 100°-102° F. On no account must the heating process be hurried otherwise the film on the outside of each particle of curd will harden too rapidly so preventing the escape of the whey and leaving the curd particles with a soft, pulpy interior, the result of which will be a wet, acidy curd

liable to lose excess fat at pressing. There is nothing to be gained by heating more slowly than is recommended above, unless the acidity of the whey happens to be particularly low at cutting, *i.e.*, .10 or .11 per cent., in which case heat may be applied more gradually. If the acidity of the whey at cutting is high, *i.e.*, .15 to .16, then the heating should be more rapid, care being taken to avoid too rapid hardening of the film around the curd particles. During the heating process the curd should be kept thoroughly stirred so as to distribute the heat evenly throughout the vat. The maximum temperature to which the curd should be heated will vary according to the quality and acidity of the milk. The lower the temperature, provided the curd is properly firmed, the better will be the texture and body of the cheese. The usual temperature in this Territory is 100° to 102° F. Higher temperatures, however, may have to be employed to firm up the curd from milk which is rich in fat—in some cases the temperature may have to be raised to 104°-106° F. Curd from milk low in butter fat can usually be firmed up at a temperature of 98° to 100° F. Heating to high temperatures is liable to cause a tough, rubbery or corky bodied cheese, and for this reason every effort should be made to firm up the curd at lower temperatures. In many cases this can be achieved by cutting the curd a bit smaller.

It should also be borne in mind that the starter bacteria do not thrive at temperatures above 98° or 100° F., which are usually more favourable for the development of undesirable types of organisms such as gas producing bacteria; if possible therefore the temperature of the curd should not be raised above 100° F., otherwise the growth of gas producing bacteria or other objectionable organisms may be encouraged.

When the maximum temperature has been reached a further acid test is taken of the whey. Usually it is found that with normally working cheese the acidity will have increased .01 to .02 over the acidity at cutting. In this case the curd may be allowed to settle in the whey and develop the required amount of acidity. The vat is covered over and every ten minutes or so the curd should be hand stirred. If, however, the acidity appears to be developing too fast to allow of proper heating the temperature should be raised a few

degrees and stirring continued. Acid tests of the whey should be taken every now and again and the curd particles periodically examined for firmness.

Removing the Whey.—The removal of the whey is the most critical stage in the process of cheddar cheese making. If the whey is run off too early before the curd has reached the proper degree of acidity and firmness, the curd will retain too much moisture and the cheese will be acid in flavour and have a soft, pasty body. If, on the other hand, the whey is removed too late, excessive acidity may be developed or the curd may be over-cooked, with the result that the cheese may be dry, mealy, brittle or tough with a strong acid flavour.

With a normally working curd the whey can usually be removed about 3-3¼ hours from the time the rennet was added. By this time, owing to the expulsion of the whey by the action of both heat and acidity, the curd particles should have shrunk considerably in size and be firm, shotty and rubbery; they should feel distinctly hard to the touch when the hand is moved through the whey, and when a handful is squeezed and suddenly released the particles should spring apart and show little tendency to stick together. The curd should show threads of ⅛ inch-¼ inch by the hot iron test, whilst the acidity of the whey surrounding the curd may vary from .18 to .24 per cent.—as shown by the acidimeter test—depending on the amount of whey in the vat when the test is taken. Some cheese makers make a practice of drawing off a large part of the whey quite early in the heating process so as to save time subsequently when removing the remaining whey. When portion of the whey is removed in this manner, the acidity of the whey remaining in the vat increases more rapidly than would have been the case had none of the whey been removed. This is due to the fact that the formation of acid takes place chiefly in the curd, the increase in the acidity of the whey being brought about mainly as the result of acid passing out of the curd particles into the whey.

The smaller the quantity of whey left in the vat the higher its acidity will be raised by the transfer of the acid from the curd to the whey.

A vat from which half or more of the whey is removed early in the heating process might, therefore, show a whey acidity of .22 to .23 per cent. two hours after cutting whereas had none of the whey been removed the acidimeter test at this stage might only be .19 to .20 per cent. The later the whey is removed the less significant this difference becomes. As previously mentioned, the main object of draining off portion of the whey early in the heating process is to save time in removing the rest of the whey when the curd has reached the desired degree of acidity and firmness. At times the cheese-maker has no alternative but to remove portion of the whey early in the process, especially if he is handling a full vat of milk or a fast working curd or if, as is frequently the case, the outlet tap of the vat is so small that the whey cannot be drawn off in less than 8 or 10 minutes. If, however, the vat has a large outlet tap and the acidity is not developing too rapidly, then it is doubtful whether there is anything to be gained by drawing off portion of the whey early in the heating process.

Considerable experience and judgment is required to decide the exact moment when the whey should be finally removed. A very common mistake is to remove the whey before the curd is sufficiently firm. The curd particles must be properly firmed and have a dry, shotty feeling before the whey is drawn. When the desired degree of acidity has been reached, as shown by the hot iron test and the acidimeter, the whey should be removed without delay. The quicker the whey can be removed the better. Whilst the whey is draining the curd should be periodically hand-stirred to prevent it from matting and to facilitate the escape of the whey. Hand-stirring at this stage is of great assistance in firming up and drying out the curd. If, as frequently happens, the desired degree of acidity has been reached but the curd is still a bit soft, then a considerable amount of hand-stirring may be necessary before the curd is properly firmed up; in this case most of the whey should be run off leaving only sufficient to keep the curd wet and stirring continued until the particles of curd have firmed up. Stirring must not be vigorous or too prolonged otherwise there may be a serious loss of casein and fat.

The whey is drained off from the vat through a sieve or strainer which holds back the curd. Draining is facilitated by making a trench in the curd down the middle of the vat and to enable the last of the whey to drain out freely the top end of the vat is usually lowered. When all, or nearly all, of the whey is out the curd is again hand-stirred before it commences to mat. A certain amount of hand-stirring—or dry-stirring as it is called—at this stage is usually necessary. Dry-stirring, by keeping the curd particles separate, allows the whey to escape and dries out the curd. The curd is usually dry-stirred for about a minute, the curd then being heaped up in the middle of the vat and allowed to drain; this process is repeated two or three times, care being taken not to over stir. When the curd feels sufficiently firm and dry it is ready for the cheddaring process.

Cheddaring the Curd.—The cheddaring process consists of allowing the curd to mat together, cutting into blocks and piling these on top of each other. After the final stirring the curd is either (1) spread out evenly in a layer about 5 to 6 inches deep on a rack covered with cheese cloth, or (2) spread out evenly in a layer about 4 to 6 inches deep on either side of the vat with a channel about 5 to 10 inches wide down the middle. The inside edge of each layer is then trimmed off with a knife and spread evenly over the top. In either case the depth of the layer of curd will depend on its condition; the firmer and drier the curd the deeper the layer may be; if, however, the curd is inclined to be soft it should not be heaped so high.

In this Colony the usual practice is to cheddar the curd on the bottom of the vat. Racks are not generally used. Some cheese-makers combine these two methods, *i.e.*, the first stages in the cheddaring process being carried out on racks, which are then removed and the cheddaring completed on the bottom of the vat.

After the curd has been spread out as described the small particles of curd on the sides and bottom of the vat are collected, usually with a curd whisk, and spread on the curd heap. The vat is then covered over with a cloth and the curd left to mat together for 15 to 20 minutes.

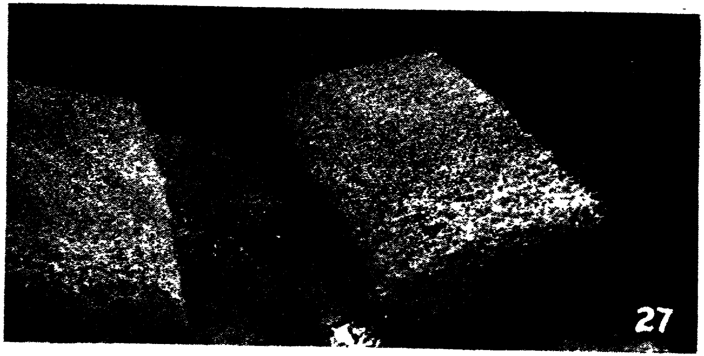

Fig. 25.—Cutting the curd crossways with the vertical knife.
Fig. 27.—The start of the cheddaring process. The curd is spread out in a layer on either side of the vat.

Fig. 26.—Dry-stirring the curd after the whey has been removed.
Fig. 28.—After about 15 to 20 minutes the curd is cut into blocks.

Fig. 29.—Blocks of curd are turned over.

Fig. 30.—Piling the curd. The blocks of curd are turned and piled every 15 to 20 minutes in layers of increasing depth until ultimately they are all piled in one heap many layers deep.

Fig. 31.—Nearing the end of the cheddaring process. The blocks of curd have flattened out considerably and are becoming smooth and velvety to the touch.

Fig. 32.—The end of the cheddaring process. The blocks of curd have flattened out into thin blankets, which can be torn apart in thin sheets showing a texture similar to the cooked breast meat of a chicken.

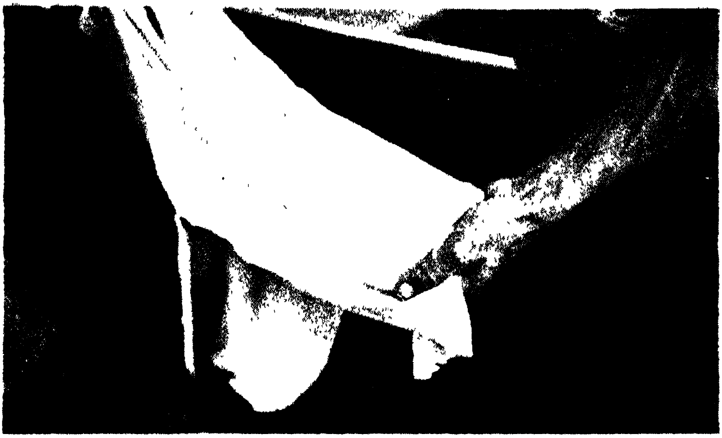

Fig. 33.—The end of the cheddaring process. The blocks of curd have flattened out into thin blankets, which can be torn apart, in thin sheets showing a texture similar to the cooked breast meat of a chicken.

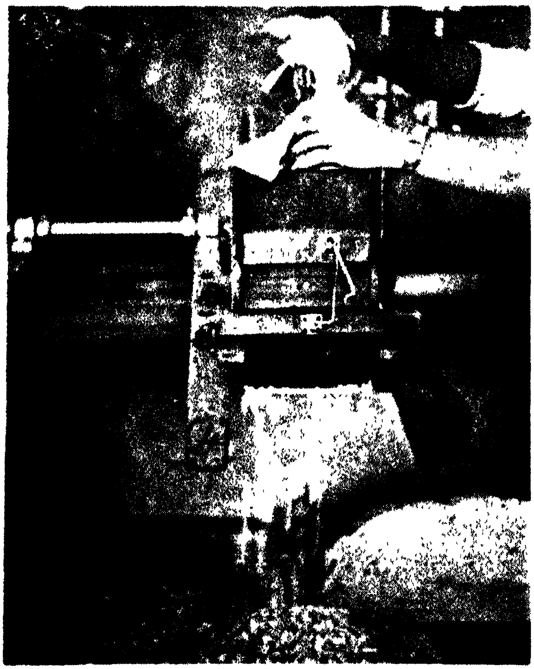

Fig. 34.—Milling the curd.

In the meantime an acidity test is taken of the whey running from the curd. This may vary from .22 to .30 per cent., or even higher, depending on the manner in which the curd has been handled. For a normal curd a fair average acidity at this stage is .24 to .26 per cent. After 15 to 20 minutes the curd should have matted together. It is then cut into square or oblong blocks about 8 by 10 or 12 inches (smaller sized blocks if the curd is a bit soft) and turned over and left for a further 15 to 20 minutes. With a firm normally working curd the blocks are then turned again and piled in layers two deep; after a further 15 to 20 minutes the blocks are again turned and piled three deep and subsequently four deep and so on depending on the condition of the curd. A firm dry curd is ultimately piled in one heap or pack many layers deep, the repiling being repeated until the curd cheddaring process is complete. A soft, moist curd on the other hand should not be piled too quickly or so deep. The curd, whilst cheddaring, should be maintained at a uniform temperature throughout and care should be taken, therefore, when piling and repiling to bring the edges and surfaces previously exposed to the air to the inside of the pack.

The temperature of the curd during cheddaring should not drop below 90° F. or 92° F. It is usually necessary to keep the vat covered otherwise the curd cools off too rapidly and cheddaring is delayed. This is especially necessary when handling a small quantity of curd; in fact, it is usually advisable to wrap a small quantity of curd in warm cloths otherwise it is almost certain to get cold. When handling a small quantity of curd it is generally necessary also to use weights during the cheddaring process otherwise the curd may not cheddar properly; after the blocks have been turned and piled a few times weights—up to 30 or 50 lb. or more, depending on the amount of curd—are placed on a board on top of the pack. Weights are not usually necessary when handling the curd from quantities of milk in excess of 200 gallons unless the curd shows signs of gassiness, in which case it may be advisable to apply weights to the curd. During the cheddaring process the blocks of curd flatten and spread out considerably and the curd changes from a tough rubbery condition to a softer, pliable mass having a silky feel and a smooth, almost velvety appearance.

These changes are associated with the development of acid in the curd. Deep and rapid piling tends to encourage the development of acidity whilst shallow piling checks acid formation and gives a drier curd. As previously mentioned use is made of this fact when handling a soft, moist curd by piling very slowly and in shallow packs. The time required for cheddaring usually varies from 2 to 3½ hours, depending on the condition of the curd when the whey is removed. A curd which has been properly firmed and dried out in the whey will usually take at least two, and probably three hours, to cheddar. Most cheese-makers cheddar for about 3 hours in this country. It is not usually necessary to cheddar for a longer period than this unless the curd is gassy, in which case it may have to be cheddared for an hour or so longer, or until the gas holes have flattened out and closed up. As previously stated, a curd which has been properly cheddared should be well flattened and be silky and pliable to the touch and have a smooth velvety appearance. It should tear out into thin sheets showing a texture resembling the cooked breast meat of a chicken. At this stage the acidity of the whey from the curd may vary from .65 to .85 by the acidimeter test, whilst the curd should draw fine silky threads about 1 to 1½ inches in length on the hot iron. The curd is then ready for milling.

Milling the Curd.—Milling consists of slicing or cutting the curd into small cubes or pieces. The object of milling is to enable salt to be evenly distributed throughout the curd and to render the latter convenient to handle when placed in the cheese moulds. In addition milling allows more whey to escape and releases undesirable odours and gasses that may have formed during the cheddaring process.

There are several kinds of mills, but the slicing or cutting type is most commonly used. The curd is cut into strips or pieces of a convenient size for milling. After being milled the curd should be well stirred by hand or with a curd fork for several minutes; this cools and aerates the curd and prevents it from matting again and allows gases and odours to escape. After being stirred the curd should be spread out on the bottom of the vat in a layer 4 or 5 inches deep. It should be stirred again every ten minutes. The temperature

Fig. 35.—Salting the curd—about 40 minutes after milling

Fig 36.—Stirring the curd after salting.

of the curd at this stage should be about 82° F. to 85° F. The curd is usually ready for salting about 40 minutes after milling. At this stage the curd will have mellowed down and have a soft, velvety feel, whilst an acidimeter test of the whey—draining from the curd will vary from .75 to .90 per cent. lactic acid; on the hot iron the curd should draw fine silky threads about 1½ inches long.

Salting.—Salt is added to the cheese to improve its flavour. It also assists in the further expulsion of whey, hardens the curd and checks undesirable fermentation. The temperature of the curd at salting should be about 82° F. A rather coarse salt of good quality should be used and it should be evenly distributed in two applications over the surface of the curd, which should be spread out over the bottom of the vat. The curd should be well stirred for a few minutes after each application. The curd is then allowed to lie in the vat for 10 to 15 minutes to enable the salt to dissolve, after which it is well stirred again and left to lie for a further 15 or 20 minutes.

The amount of salt to use depends on the composition of the milk and the condition of the curd. For ordinary purposes, *i.e.*, for milk of average quality, 2 lbs. of salt per 100 gallons of milk should be sufficient. A soft moist curd is usually salted more heavily than a firm dry curd. The quantity of milk, however, does not provide a very satisfactory basis for calculating the amount of salt required. 100 gallons of milk containing a high percentage of butter-fat will yield a greater quantity of curd than 100 gallons of milk of low butter-fat content, so that if the quantity of salt added is calculated on the gallonage of milk it follows that the curd from the rich milk will in all probability be undersalted. Furthermore, at certain seasons of the year in this country the yield of curd per gallon of milk is very low, and if salt is added at the usual rate the cheese will be oversalted. Excessive salt produces a dry, mealy, slow curing cheese.

A more satisfactory method is to base the quantity of salt used on the actual weight of milled curd. In this case salt should be added at the rate of 1 lb. to 50 lbs. curd. Few cheese-makers, however, will trouble to weigh the curd for this purpose.

Where the percentage of fat in the milk is known salt can be added according to the following table:—

Per cent. of fat in milk.	Quantity of salt used.
3.0	$1\frac{3}{4}$-2 lbs.
3.5	2 lbs.
4.0	$2\frac{1}{2}$ lbs.
4.5	3 lbs.

After the salt has been added the curd feels dry and rough. When this dryness and roughness has disappeared and the curd has regained its mellow, silky feeling, it is ready to be placed in the cheese moulds. This will usually be about 40-45 minutes after salting. At this stage the curd should be very firm, and when squeezed in the hand it should offer considerable resistance and spring back like rubber.

Moulding and Pressing the Curd.—The type of cheese mould used in this country is the Australian steel telescopic mould. This particular mould consists of two lids, a flexible steel lining and a solid steel collar into which the flexible steel lining fits. These moulds are obtainable in varying sizes to make 2 lb., 5 lb., 10 lb., 20 lb., 25 lb., 40 lbs., 60 lb. and 80 lb. heads of cheese. The curd is usually placed in the mould in the following manner. The flexible steel lining is placed in the bottom lid on which is then placed a circular piece of hessian of diameter slightly less than that of the lid. The flexible steel lining is then lined with a piece of tubular cheese bandage cut so as to overlap about $1\frac{1}{2}$ inches at the top and bottom. A circle of stiff muslin (cheese cap) is placed inside and the collar portion is then fitted on, being held in position by two clips. The curd is then pressed tightly into the mould, the same amount of curd being placed in each mould. A cheese cap and hessian circle similar to that already used is now placed on top of the curd and the lid is put on. The mould is then ready to be placed in the press. In filling the mould care must be taken to press it well in and down, especially around the sides. In order to have cheese of uniform size it is necessary to weigh the curd into each mould. This is something which is frequently neglected.

Fig 37.—Putting the curd into the moulds.

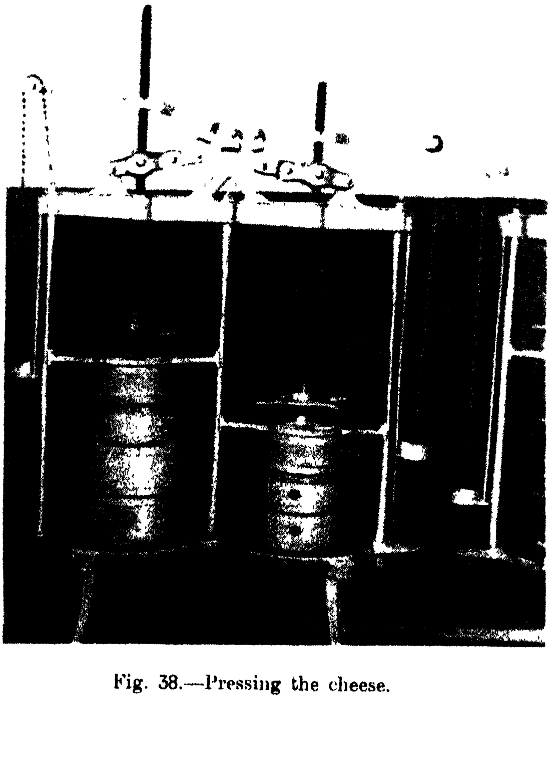

Fig. 38.—Pressing the cheese.

Fig 39 -Removing the cheese from the mould

Fig. 40.—Bathing the cheese in hot water. The cheese is immersed in water at 140° F. for 1 minute.

Cheese of uniform size is easier to pack than odd sized heads. The temperature of the curd when placed in the mould should be about 78° to 80° F., although lower temperatures are occasionally necessary. Small heads can usually be moulded and pressed at slightly higher temperatures than the larger heads. Pressing at too high a temperature may cause excessive loss of fat, uneven colour and a dry body. If pressed at too low a temperature the curd may not knit together properly resulting in an open texture; the curd may also retain too much whey and have an open rind through which mould growth may enter the cheese.

In pressing the curd care must be exercised to apply the pressure lightly and gradually for the first hour. If pressed too rapidly at first excessive fat may be lost or else the rind may form so quickly that the whey cannot escape and the cheese may subsequently leak in the curing room. With a screw press sufficient pressure is given to start the whey running freely and the press is then tightened as fast as the screws become loose until at the end of about 25 minutes the whole pressure of the screw is brought to bear. After about three-quarters of an hour the pressure is increased by the addition of one of the weights, another being added a quarter of an hour later and so on until full pressure—10-25 cwts., according to the size of the cheese—is reached at the end of about two hours.

An acid test of the whey at pressing should show about .90 to 1.1 per cent. Full pressure is maintained for 20 to 24 hours. The cheese should then be taken out of the press, removed from the mould and bathed in water at a temperature of 140° F. for one minute. This washes out any fat that may have collected on the surface of the cheese and helps to form a good close rind. The bandage should be pulled up to remove wrinkles and be trimmed and the cheese returned to a clean mould and be placed back in the press. Pressure should be continued for another 24 to 48 hours according to the size of the cheese. Large sized heads, *i.e.*, 40 lb., 60 lb. and 80 lb. heads should, whenever possible, be pressed for fully three days. The cheese is then removed from the mould, wiped dry with a clean cloth, marked with the date of manufacture, etc., and placed in the curing room, when it should

be turned daily for at least a month so that the rind may dry evenly and the moisture may not leak to one end of the cheese.

CLEANING AND STERILISING THE CHEESE VAT.

The proper cleaning and sterilisation of the cheese vat as well as all other utensils, curd knives, strainers, etc., is essential for the manufacture of good cheese. It is astonishing, however, how frequently this requirement is neglected.

All small utensils after being properly cleaned, *i.e.*, rinsed first with cold water, then scrubbed with a scrubbing brush and hot water and cleaning powder and finally rinsed again in hot water—may be sterilised in the steam steriliser previously mentioned.

The cheese vat on account of its size, however, requires special cleaning. As soon as the curd has been removed from the vat—usually at moulding—the vat should be thoroughly scrubbed with whey or warm water; it should then be scrubbed a second time with boiling hot water containing soda or other cleaning compound, after which it should be rinsed with boiling water; the water is then drained off from the jacket and the vat and the latter is then ready to be sterilised. The most effective method of sterilising the vat is by steam. A zinc or tin lined wooden cover is placed over the vat and a steam hose inserted. Steam under pressure is then discharged into the vat for about five minutes after which the cover is removed to allow the steam to escape. The heat generated should be sufficient to dry up all moisture in the vat. In the absence of a steam steriliser in which the smaller utensils can be sterilised, equipment such as curd knives, strainers, etc., can be steamed in the vat as described. If steam is not available sterilisation of the vat will have to be effected by means of some chemical steriliser of which there are several kinds on the market. Some of these are obtainable in powdered form and are most effectively used with hot water.* Sterilisation by steam is, however, to be preferred.

Care must be taken to clean out the tap daily with a brush, otherwise curd may collect in it and form a source of contamination.

Fig. 41.—Dressing the cheese and trimming the bandage.

Fig 42.—Cheese in the curing room.

After being steamed and dried the vat should be covered over to keep out dust and flies. The outside should be washed daily and any brass or bright metal parts should be kept well polished.

The inner lining of the vat should be frequently examined for leaks. Leaks do occur, and although they may at times be so small as to be undetectable, they can nevertheless prove a source of serious contamination and spoil considerable quantities of cheese.

Curing the Cheese.—There is a considerable amount of truth in the saying that cheese is only half made when taken from the press, for there is little doubt that the conditions under which the cheese is cured and stored have a very marked effect upon its ultimate quality. If cured or stored at too high a temperature the cheese will ripen too quickly and a coarse flavour will probably result, or else undesirable fermentations will develop causing the cheese to become "puffy" or to blow up like a football, etc.; high temperatures will also cause the cheese to lose fat or to "sweat," resulting in considerable loss in weight and causing serious injury to its body and texture.

The ideal ripening or curing temperature is considered to be 55° F., but this is almost impossible to attain in this country—except during the winter—without the aid of artificial refrigeration. Actually very much lower temperatures than this may be used for curing cheese with very satisfactory results, the only drawback being that the ripening process is very much prolonged and the cheese is not ready for consumption for seven or eight months.

Satisfactory results can be obtained, however, as long as the temperature of the curing room is not allowed to rise above 65° F. At this temperature the cheese will mature in about 2½ to 3 months; thereafter, if not consumed, it should be placed in a cold store where it should be kept at a tem-

perature of 30° F. to 40° F. Cheese which is cured and stored in this manner should—if it has been properly made—keep for at least 9 or 10 months, or even longer, without deteriorating; in fact, a really good cheese should improve in flavour during this period. At certain times of the year in this country it is very difficult to bring the temperature of the curing room down below 70° F., with the result that a considerable quantity of cheese is spoiled every year by sweating. In these circumstances the cheese-maker would be well advised to send the cheese to a cold store as soon as it is fit to travel, *i.e.*, about three weeks old. The cheese should be very carefully packed so as to avoid damage en route to the cold store. Every effort should be made to keep the cheese curing room airy and cool. If properly constructed to exclude hot winds and direct sunshine the temperature should not at any time exceed 70° F. The doors and windows must be tightly fitting and should be placed on the south and east sides. If an insulated ceiling and insulated or double walls are provided and the doors and windows are kept closed during the day and thrown open at night it should be feasible to maintain a fairly equable temperature during the warm weather.

Cheese factories operating on a fairly large scale should be equipped with artificial refrigeration and properly insulated curing rooms.

A certain amount of humidity is also necessary in the curing room to prevent too rapid drying out of the cheese, cracked rinds, etc., but if the air is too damp or if there is insufficient circulation of air mould growth will soon appear on the cheese. The relative humidity of the curing room should be about 75 to 80 per cent. as measured by the wet and dry bulb thermometer. The following table will give some idea of the humidity in the curing at various temperatures for each degree or more difference between the wet and dry bulb thermometer readings.

Relative Humidity from Wet and Dry Bulb Thermometers.

Dry Bulb. T° F.	Difference between Wet and Dry Bulbs.—Degrees °F. 1°	2° Approx. %	3°	4°	5°	6° Humidity.	7°
40	92	84	76	68	59	52	44
45	92	85	78	71	64	57	50
50	93	87	80	74	67	61	55
55	94	88	82	76	70	65	59
60	94	89	84	78	73	68	63
65	95	90	85	80	75	70	65
70	95	90	86	81	77	72	68
75	95	91	87	82	78	74	70
80	96	92	87	83	79	75	72

Example.—If the temperature by the dry bulb thermometer is 65 F. and the reading on the wet bulb thermometer is 60° F., i.e., a difference of 5°, then the relative humidity in the curing room will be 75%.

Two dairy thermometers will do—one covered with a small wick or thin muslin or cheese cloth (one thickness) dipping into a small bottle of water—3 inches below and a little to one side. Raising the temperature lowers the humidity, provided the amount of moisture in the air remains constant. This commonly occurs in summer.

Cleanliness in the curing room is essential. The shelves should be kept clean and should be frequently scrubbed with plenty of hot water and soda or other suitable cleanser. It must be emphasised also that the curing room is designed solely for the purpose of curing and ripening the cheese and should not, as is frequently the case, be used as a store room for items such as salt, packing crates, carpenter's tools, etc.

Curing Room Pests.—Curing rooms frequently become infected with one or more of the following pests:—

1. *Mould.*—A certain amount of mould—generally blue mould—is found in almost every curing room, but it does not usually do much harm to the cheese as long as the rind is free from cracks. Certain types of mould, however, may affect the flavour of the cheese and mould growth is in any case unsightly and detracts from the appearance of the cheese.

Mould growth can usually be kept in check by ensuring good circulation of air, avoiding excessive humidity and by keeping the curing room clean. A curing room which is infected with mould should be treated as follows:—

1. All shelving, walls, floors and ceiling should be scrubbed with hot water and washing powder. The shelves, if removable, should be placed in the sun to dry after being scrubbed with hot water. The interior of the curing room should then be white-washed, using unslaked lime for making up the white-wash.

2. When dry the shelves should be rubbed with a solution of formalin (1 part commercial formalin to 500 parts water).

3. The cheese should all be washed and then rubbed with a formalin solution of the strength indicated above, the formalin treatment being repeated after 48 hours. All cheese showing defective rinds should be disposed of without delay.

4. If the curing room is badly infected then fumigation is advisable. Formaldehyde gas is most commonly used and lamps or candles which on combustion liberate this gas can be obtained for this purpose. Small rooms can be fumigated by pouring formalin over crystals of potassium permanganate in an earthen vessel—3 pints of formalin to 23 ounces of permanganate is used per 1,000 cubic feet of room space. The potassium permanganate is placed in an ordinary paraffin tin standing in a larger vessel containing a little water. The formalin is then poured into the paraffin tin and the room closed for 6-10 hours. The rooms must be tightly sealed. Whenever possible the services of an expert fumigator should be obtained.

2. *Cheese Mite.*—Cheese mite are small, whitish or colourless parasites which can only be clearly detected when accumulated in large numbers on the surface of the cheese or on the shelves when they appear as a fine pale brown powder composed of living and dead mites, eggs, particles of

excreta, uneaten cheese, etc. It is said that a thimbleful of this powder may contain 50,000 mites. These mites destroy the rind of the cheese and produce a very unwholesome appearance. When feeding in large numbers they not only make holes several inches deep but sometimes work in all directions under the rind and undermine it. If not checked the mites will ultimately reduce the entire cheese to powder. Under favourable conditions of temperature, food, etc., mites may increase at an exceedingly rapid rate. They are present in many cheese factories in small numbers at least and gain entrance to the curing room by being carried in either by flies or cockroaches or on the hands or clothing of the factory employees. They seldom attack new cheese and do not thrive at low temperatures, *i.e.*, at temperatures below 40° F. At temperatures of 50° F. and above, however, the mites become very active and may do a considerable amount of damage.

They can be kept in check by low temperatures—curing rooms or store rooms which are maintained at 30°-35° F. are seldom troubled by cheese mites. If the curing room is badly infected fumigation will be necessary. The fumigation previously mentioned may be used for this purpose.

3. *Cheese Fly.*—This is a small fly—about one-third the size of a house fly with a distinct liking for cheese and which lays its eggs singly or in groups in cracked rinds or on the moist surface of the cheese. Its life history passes through four distinct stages. The eggs hatch out into the well known "skippers" or "jumper" (the larval stage) which later changes into the pupa from which the adult fly eventually emerges.

The best method of control is to prevent the entrance of the fly into the factory or curing room.

The "skippers" are very resistant to chemicals. Storing or curing the cheese at low temperatures (30°-35° F.) will prevent loss from "skippers." Fumigation is effective except against pupae which may be buried deep in the cheese.

The frequent occurrence of the pests enumerated emphasises the importance of sanitary conditions in the curing room and the need for frequent cleansing of curing room

shelves and the removal of damaged or unsaleable cheese. Damage to cheese by these pests can usually be prevented by attention to the sanitary measures previously mentioned.

Packing and Despatching Cheese.—Cheese when despatched to the local market by rail or lorry should be properly packed in wooden crates which may be of the rectangular box type holding two fair sized heads or else the 6 or 8-sided vertical crate holding 2 to 4 heads, depending on the size of the cheese. An alternative packing is the especially constructed stiff cardboard box which is quite extensively used to-day.

The popular sizes for the local market are 10 lb., 20 lb., 40 lb. and to a lesser extent 60 and 80 lb. heads.

The packing should be neat and tidy and the crates should be strongly constructed and firmly put together. Care should be exercised in loading the cheese into the train or lorry not to pile the crates too deep on top of each other, otherwise the bottom crate may collapse and the cheese therein be squashed out of shape.

The cheese should not be exposed to high temperatures whilst travelling otherwise it will sweat and deteriorate. This can usually be avoided by arranging for the cheese to travel at night or during the cooler part of the day. For railing large consignments an insulated truck should be used.

Packing of Cheese for Export Overseas.—Cheese intended for export overseas must be prepared in 60 lb. or 80 lb. sizes and should be packed in standard crates complying with the following requirements:—

1. Each crate must be large enough to hold two heads of cheese.
2. Each crate must have 12 sides of which each contiguous pair forms a similar angle.
3. The ends of the crate must be of wood planed smooth on the outside and not less than $\frac{7}{8}$ inch thick.
4. Each crate should have a centre board not less than $\frac{3}{4}$ inch thick and which must be securely nailed through each batten.

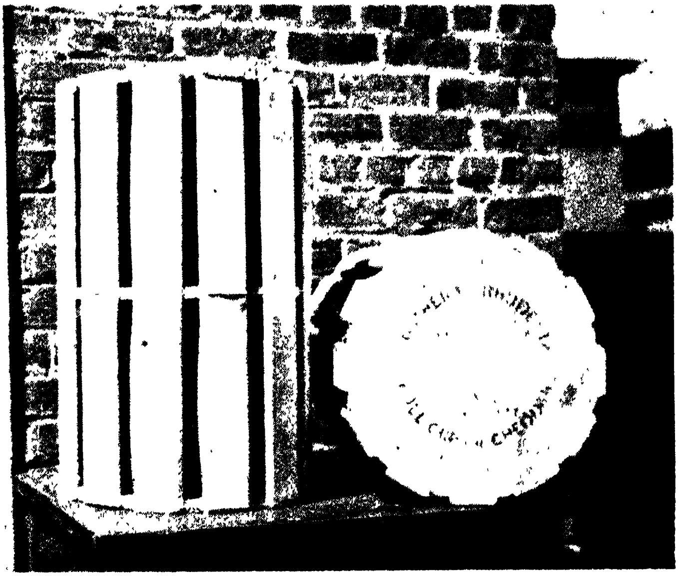

Fig 43 Type of crate and markings required for cheese intended for export overseas.

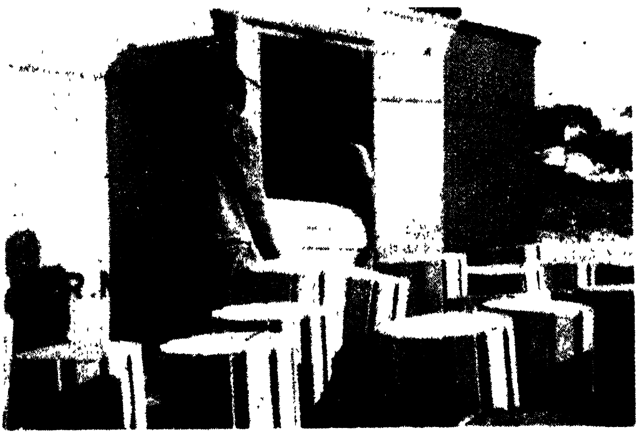

Fig. 44 —Loading cheese into a refrigerator truck for export overseas (Zawi, S. Rhodesia).

5. For 80 lb. heads the ends and centre board of the crate should measure not less than 15 inches between each opposite pair of sides and for 60 lb. heads not less than 14 inches.

6. The sides should be made of battens of varying length, depending on the weight and size, etc., of the cheese the crate is designed to contain; the battens should be not less than 3 inches or more than $3\frac{1}{4}$ inches wide and not less than $\frac{3}{8}$ of an inch or more than $\frac{1}{2}$ an inch thick; the outer edges of the battens should be bevelled.

7. The crates should be neatly bound at each end and at the centre with non-rusting wire of at least 14 gauge and secured with staples.

8. The wood should be well seasoned and free from cracks, loose knots or other defects likely to cause the cheese to suffer damage.

9. The nails used should be $1\frac{1}{2}$ to $1\frac{3}{4}$ inch by 13 gauge and should have flat heads.

10. One or more scale boards (a thin circular slice of wood) should be placed at each end of each cheese and each cheese should be packed so as to fit firmly and not allow undue space or movement in the crate.

11. Each crate should be legibly marked on each end with

    (*a*) The registered number of the factory and the consecutive number of the crate in letters or figures about $\frac{1}{2}$ inch square.

    (*b*) With the net weight of the contents and with the words "Southern Rhodesia" and with the word "Coloured" or "White," according to whether the contents have been coloured or otherwise, in figures or letters $\frac{3}{4}$ to 1 inch in height.

12. Only cheese of the same quality and manufactured on the same date and from the same batch of milk may be packed together in the same crate. If odd

cheeses are packed together in the same crate the markings on the crate must clearly indicate the contents and the position in the crate of each different make of cheese.

Fig. No. 43 illustrates the type of crate, marking, etc., which should be used for packing cheese for export overseas.

COMMON DEFECTS IN CHEDDAR CHEESE.

Defects commonly found in cheese may be divided into four classes.

1. Defects in flavour and aroma.
2. Defects in body and texture.
3. Defects in colour.
4. Defects in finish and general appearance.

1. **Defects in Flavour and Aroma.**—The true flavour of high grade cheddar cheese is not easy to define. Cheddar cheese should have a clean, nutty, mellow flavour, pleasing to the palate and without coarseness or pronounced "bite" to the tongue. Although some people prefer a strong flavour the popular demand in this Colony is undoubtedly for a mild flavoured cheese. The following are the most common flavour defects in locally made cheddar cheese.

(1) *Sour, Acidy Flavour.*—This defect is usually accompanied by a rough, mealy or even crumbly body and a pale bleached colour is caused by the development of excessive acidity at some stage or other of the cheese making process. Excessive acidity may be the result of using night's milk, using too much starter or over-ripening the milk before adding the rennet. The most common cause, however, is the failure to firm the curd sufficiently before removing the whey with the result that the curd retains too much moisture and develops excessive acidity in the subsequent stages of the manufacturing process.

When it is known that the milk is more acid than usual the manufacturing process may be varied slightly so as to avoid a sour acid cheese, *viz.* :—

(i.) Use less or very little starter.

(ii.) Set at a higher temperature—88°-90° F. (Some expert cheese makers set at a lower temperature—80°-82° F.)

(iii.) Use more rennet.

(iv.) Cut the curd finer than usual.

(v.) Heat the curd more rapidly and raise to a higher temperature.

(vi.) As soon as the maximum temperature has been reached draw off most of the whey and continue stirring vigorously until the curd firms up. Continue stirring the whole time the remainder of the whey is escaping and dry stir after the whey is removed.

(vii.) The curd should be spread out in a shallow layer in the vat so as to allow the whey to escape—racks are very useful at this stage. After matting the curd should be cut into small blocks—4 inch x 4 inch x 8 inch—and turned every five minutes to facilitate the escape of the whey. The blocks should be piled in very shallow layers. Mill early and salt early and use more salt.

(viii.) An acid curd is sometimes rinsed with clean, pure water of the same temperature immediately after drawing off the whey or alternatively the whey is removed earlier in the process and replaced with an equal amount of water at the same temperature in which the heating and firming up of the curd is completed, the water being then removed and the curd vigorously stirred to allow the moisture to drain away.

(2) *Food Flavours.*—These flavours are caused by feeds, weeds or wild fruits eaten by the cows. The commonest feed taint is that caused by ensilage. Of the weeds the Mexican Marigold (khaki-bos) *Tagetes minuta* and wild garlic (*Tulbaghia alliacea*) usually produce the worst flavours, whilst taints are also commonly caused by the fruit of the "Mahobohobo" and the "Muhatja" and "Marula."

Foods liable to cause a taint in the milk such as ensilage, should be fed after milking. Once the taint is in the milk there is not much that can be done to remove it other than to aerate the milk by passing it over a cooler, using plenty of good starter, heating the curd higher than usual to expel the odour and aerating it thoroughly after milling.

(3) *Fruity Flavour.*—These are sweet, sickly flavours with odours reminiscent of certain ripe fruits such as pineapple, etc. They are believed to be caused by certain yeasts and bacteria found in dirty, unsterilised milk cans; placing milk in cans which have contained whey will usually give rise to this trouble; a leaky vat is also a common cause.

Fruity flavours can be prevented by observing strict cleanliness in the factory, using special containers for conveying whey from the factory, boiling all cloths used in the cheese making process and by proper cleaning and sterilisation by steam of all cans and other utensils and equipment.

If a fruity flavour is detected during the cheese making process then the cheese-maker should develop more acidity and dry out the curd more than usual, use more salt and aerate the curd thoroughly after milling and salting.

(4) *Off Flavours.*—The term "off flavours" includes all flavours that are not clean or that are otherwise offensive or objectionable. They are usually caused by individual bacteria which gain entrance to the cheese from dirty milk, dirty or unsterilised utensils, bad starter and bad rennet, impure water, leaky vats, etc. The development of these flavours can be avoided by the observance of scrupulous cleanliness in the factory and by regular testing of the milk supply and discarding of all milk which does not conform to the requirements of the Methylene Blue and Fermentation tests previously described.

Off flavours can frequently be detected during the cheese making process. In this case more acidity than usual should be developed and the curd should be well dried out and firmed up before removing the whey. The curd should be thoroughly aerated after milling and slightly more salt should be used. Curing the cheese at low temperatures, *i.e.*, 40°-45° F. will sometimes assist in checking the development of "off flavours."

The most common off flavour found in locally made cheese is that produced by gas forming bacteria, the presence of which can very often be detected during the cheese-making process; in fact, in bad cases the curd will float and have a sponge like appearance. Acid development may be checked and the curd may acquire a most objectionable, disagreeable odour.

When the whey has been removed the curd may show the characteristic "pin-hole" appearance, *i.e.*, a cut surface will show innumerable minute pin holes. Sometimes the gas holes and the characteristic flavours and odours do not develop until the cheese is in the curing room.

In some cases the flavour and odour may be so offensive as to render the cheese quite unsaleable. Generally speaking gassiness in milk and cheese is associated with unhygienic methods of production and is preventable. On the other hand it is well known that gassiness may also be caused by allowing cows to graze in vleis or on rank or immature grass. The presence of gas producing organisms can always be detected by means of the Fermentation or Curd Test.

If the presence of gas in the milk is suspected then the quantity of starter used may be considerably increased. In fact, when the milk is grossly infected with gas as much as 5 per cent. of starter can be added with good effect. The milk is also ripened to a greater degree than usual before the rennet is added and more acidity is developed before removing the whey; the curd should not be heated in the whey to quite such a high temperature as usual but should be firmed up at 97°-98° F. if possible. If the curd floats then the greater part of the whey should be run off leaving just sufficient to enable the development of acid to proceed. There is, however, little hope of making a satisfactory cheese when the fermentation has reached this stage. Whilst cheddaring the curd should be piled high and should not be milled until the gas holes have flattened out and the curd will draw threads fully 2 inches long on the hot iron. The curd should be stirred and aerated frequently to facilitate the escape of gas. It may be advisable to mill the curd twice. A longer interval should be allowed between milling and salting and slightly

more salt should be used. If possible the cheese should be cured at low temperatures.

It is claimed by some cheese-makers that the addition of saltpetre to the milk—at the rate of 1 ounce to 20 gallons of milk—will assist in checking the development of gas during the cheese-making process. There appear to be no grounds for this contention. Furthermore, it has been shown that certain bacteria are capable, in the presence of saltpetre, of causing serious colour defects in cheddar cheese. The use of saltpetre, therefore, is not recommended.

2. **Defects in Body and Texture.**—Cheddar cheese, when properly made, has a firm, solid meaty body of smooth appearance and consistency. When squeezed between the thumb and forefinger the cheese should feel smooth and putty-like and should not be rough, gritty or mealy. A core when broken should show a clean flinty break.

(1) *Dry Body.*—Dry-bodied cheese is tough, corky, crumbly or mealy. This defect may be caused by using milk that is low in butter fat but is more commonly the result of heating the curd too long in the whey or to too high a temperature, excessive dry stirring, using too much salt and over-pressing. This defect, which is usually preventable, should not be confused with "acid body."

(2) *Acid Body.*—Cheese with an acid body is also dry and mealy and sometimes crumbly, but can be distinguished from a typical dry-bodied cheese by its colour, which is usually pale and bleached and by its sour flavour. Dry-bodied cheese usually has a clear even colour. As mentioned elsewhere an acid body is caused by excessive acidity at some stage or other of the manufacturing process.

(3) *Open Texture.*—Open textured cheese usually contains excessive moisture, is soft in body and shows numerous mechanical holes, *i.e.*, it lacks the close texture of a well made cheddar cheese.

This defect is most commonly caused by not developing sufficient acidity, not cheddaring properly, pressing at too high a temperature, insufficient pressing and curing at high temperatures.

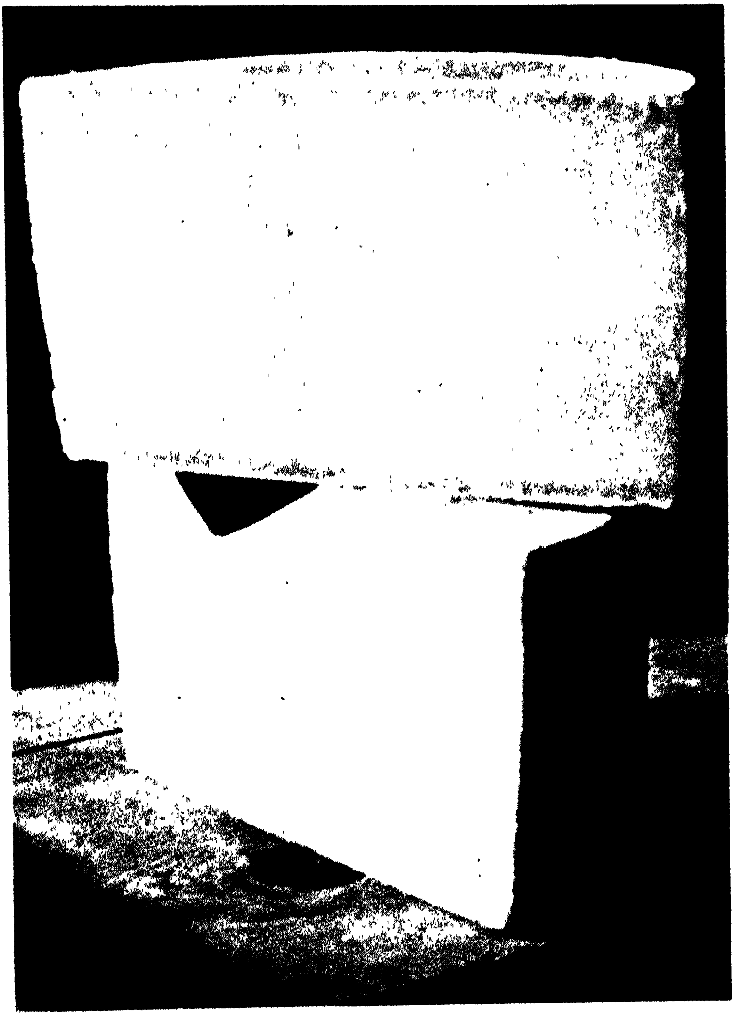

Fig. 45 —A cut cheese showing good texture and a close, meaty body.

3. **Defects in Colour.**—A well made cheddar cheese will have a bright even colour throughout.

(1) *Acid Cut Colour.*—A pale, bleached, "acid cut" colour is invariably associated with sour, acidy cheese. As previously mentioned, this is due to the development of excessive acidity which bleaches the colouring matter in the cheese.

(2) *Mottled Colour.*—The cheese shows an uneven colour. This defect is preventable and is caused by uneven development of acidity and distribution of moisture in the curd, uneven cutting, the use of lumpy starter, uneven piling and packing of the curd whilst cheddaring, the use of inferior cheese colour and the addition to the fresh curd of curd left over from the previous day's manufacture. As previously mentioned uneven colour may also be caused by a combination of saltpetre and certain bacteria.

(3) *Seamy Colour.*—Cheese with this defect shows the outline of each particle of curd. It is usually caused by a greasy curd or by adding the salt too rapidly or using impure salt.

4. **Defects in Finish.**

(1) *Cracked Rinds.*—As the term implies, these are openings or cracks in the rind of the cheese. These cracks or openings in the rind not only detract from the appearance of the cheese but also allow of the entrance of cheese flies and mould. They are usually caused by excessive acidity, greasy curds, over-salting the curd, insufficient pressing, pressing at too low a temperature, excessive loss of fat at pressing, rough handling of the cheese after removal from the press and too rapid drying of the cheese in the curing room. Care in pressing, dressing and bathing the cheese and the use of an outer bandage will usually prevent this defect.

(2) *Dirty, Mouldy Appearance.*—This explains itself. A dirty appearance can easily be prevented by keeping the curing room shelves clean, by using only clean, rust-free cheese moulds and by handling the cheese only with clean

cloths and hands. As mentioned elsewhere, a certain amount of mould, particularly the ordinary blue mould, will not do the cheese very much harm, although it detracts from its appearance. The necessary measure for the prevention and control of mould growth have already been described.

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Photographs: Figures 3-11 inclusive taken by J. R. Cooksey, Salisbury.

Photographs: Figures 20-42 inclusive taken by Lennons, Ltd., Bulawayo.

Rhodesian Milk Records.

SEMI-OFFICIAL.

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B. Fat in llbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Bonnie I.	G. Friesland	5314.00	200.21	3 77	278	Boyd Clark Est., Castle Zonga, Inyazura.
Winifred	G. Shorthorn	4782.80	248.46	5.19	300	E W. Brighten, Castle Base, Rusape.
Yvonne	G. Friesland	5046.70	216.84	4 30	281	
No. 233	G. Friesland	6304.50	206.54	3.28	300	Coldstream Dairy, P.O. Headlands.
No. 267	G. Friesland	7132.00	253.59	3.56	300	
Binkie	G. Red Poll	5357.80	206.93	3.86	300	Hon. H. V. Gibbs, Bonisa, Redbank.
Dolly	G. Friesland	6626.60	232.84	3.51	300	
Hila	G. Friesland	6146.10	214.41	3.49	300	
Fanny	G. Friesland	5751.40	253.63	4 41	300	
Fatty	G. Friesland	6476.30	221.74	3.42	300	
Freda	G. Friesland	5510.30	202.32	3.67	300	
Lass	G. Friesland	6054.50	212.95	3 51	300	
Maisie	G. Friesland	6406.90	233.20	3 64	300	
Roma	G. Friesland	5460.50	201.82	3.70	300	
Show	G. Friesland	6083.90	217 80	3 53	300	
Vera	G. Friesland	4344.20	210.32	4 84	300	
Candy	G. Friesland	4834.50	202.38	4.19	300	F. H. R. Maunsell, Forres, Bromley.
Iota	G. Jersey	4210.00	206.53	4.91	300	
No. 190	G. Friesland	7426.00	269.76	3.63	300	Meikle Bros., Leachdale, Shangani.
No. 209	G. Friesland	9466.00	297.92	3.15	300	
Flossie	G. Friesland	6035.80	259.56	4.30	300	Capt. W. M. Nash, Chakadenga, Marandellas.
Chume III	G. Friesland	6038.40	261.03	4.32	272	Red Valley Est., Lushington, Marandellas.
Manduza II.	G. Friesland	5534.50	734.93	4 24	300	
Sisiria II.	G. Friesland	8217.10	306.72	3.73	300	
Spoon I.	G. Friesland	5002.30	204.65	4.09	300	

RHODESIAN MILK RECORDS.

SEMI-OFFICIAL.—(Continued).

Name of Cow. Breed.	Breed.	Milk in lbs.	B. Fat in llbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Paddock	G. Friesland...	6484.00	250.35	3 86	300	Red Valley Est 'P' 'Herd, Lushington, Marandellas.
Petal	G. Friesland...	5904 30	238.23	4.03	300	
Profit	G. Friesland	6702.00	236.52	3.53	300	
No. 60	G. Ayreshire	6724.50	286.08	4 25	300	Rhodes Matopo Est , P.B. 19K., Bulawayo.
No. 65	G. Ayreshire	6023 30	237.81	3.95	300	
No. 75	G. Red Poll	6898.60	312.84	4.53	300	
No. 86	G. Red Poll	5088.80	226.10	4.44	300	
No. 87	G. Red Poll	6489 10	257.79	3.97	269	
No. 98	G. Red Poll	5410.00	216.36	4.00	300	
Whinburn Laughter ...	App. Friesland...	6261.40	209.91	3.35	292	R. R. Sharp, Whinburn, Redbank.
Whinburn Prudence ...	App. Friesland...	6282.20	233.22	3.71	300	
Darby	G. Friesland... . . .	7343.50	298.10	4.06	300	W. E. Tongue, North Lynn, Bulawayo
June	G. Friesland.	7610.00	251 53	3.31	300	
Beatrix	G. Friesland.	7542.00	274 02	3.63	300	

RHODESIAN MILK RECORDS.

OFFICIAL.

Name of Cow.	Breed.	Milk in lbs.	B. Fat in lbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Matopo Brightwell Cackler. 13.10.1931	Red Poll	6678.90	247 76	3.71	300	Rhodes Matopo Est., P.B. 19K., Bulawayo.

Southern Rhodesia Veterinary Report.

DECEMBER, 1940.

DISEASES.

Anthrax diagnosed at Madangombe Tank, Chibi Native Reserve, in the Chibi Native District.

TUBERCULIN TEST.

One bull and sixty-one cows were tested on importation; one cow reacted to the test and was destroyed.

MALLEIN TEST.

One horse was tested with negative results.

IMPORTATIONS.

From the Union of South Africa.—Bulls, 1; cows, 61; sheep, 1,926.

From Bechuanaland Protectorate.—Sheep, 250.

EXPORTATIONS.

To the Union of South Africa.—Horses, 1.

To Northern Rhodesia.—Bulls, 6.

To Portuguese East Africa.—Slaughter cattle, 29; sheep, 60; goats, 30.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom.—Tongues, 5,646 lbs.; livers, 16,536 lbs.; tails, 4,255 lbs.

To Northern Rhodesia.—Beef carcases, 143; mutton carcases, 25; veal carcases, 3; offal, 5,883 lbs.

To Belgian Congo.—Beef carcases, 31; mutton carcases, 4; pork carcases, 30; veal carcases, 3; offal, 302 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa.—Corned beef, 59,832 lbs.; beef fat, 47,000 lbs.; beef paste, 42,200 lbs.; tongues, 1,416 lbs.; sausages, 313 lbs.; tin stew, 30,720 lbs.

To Northern Rhodesia.—Meat meal, 3,000 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-40.

Monthly Report No. 97. December, 1940.

Red Locust (*Nomadacris septemfasciata,* Serv.).—Eleven (11) districts reported winged swarms during December, namely, Salisbury, Mazoe, Mrewa, Mtoko, Inyanga, Melsetter (S.), Bikita, Victoria, Chibi and Wankie.

Egg-laying has taken place in the districts of Mrewa, Mtoko, Inyanga and Melsetter (S.). In Mtoko district it is stated to have been extensive. Breeding colouration was recorded in specimens from some other districts.

Flocks of storks and other birds have been following the swarms in several districts. In one district it was estimated that the birds numbered about ten thousand (10,000).

Some damage to maize has been reported.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

Vol. XXXVIII.] No. 3 [March, 1941

Editorial

Notes and Comments

Natural Resources.

It is safe to say that the greatest forward step in the agricultural history of Rhodesia is marked by the Natural Resources Bill, 1941, which it is proposed to introduce during the main session of the Legislative Assembly No more enlightened piece of legislation has appeared in this or any other country in recent years. The Bill recognises, what some other countries realised too late, that the soil is a national heritage and not a negotiable commodity to be squandered recklessly and selfishly for private and commercial ends. The dust bowl of America is a byword in agriculture and served to draw attention vividly to what had been happening in practically all countries. The rapidity and the completeness of the devastation of the soil's fertility in these areas was only a particularly striking example of a process inseparably linked with agricultural practice. The process of soil erosion and denudation, the check to drainage and the falling of the ground water table have not proceeded in Rhodesia to fatal extremes, but already in the Mazoe Valley there are huge areas where the top soil has been sliced completely away and the fertility enormously reduced. The damage to these areas would have been much more apparent had it not been for the extreme depth of soil. Under tropical conditions the raw sub-soil may in time form a fertile top-soil, but the long

process of organic and bacterial accumulation requires to go on undisturbed and is impossible under cultivation which, continued, would lead to the complete exhaustion of the land.

In terms of the Bill the Natural Resources Board shall have as one of its functions general supervision of natural resources, the greatest of which is unquestionably the soil. On the recommendation of the Board the Minister of Agriculture and Lands can in the public interest construct and maintain on any land works for the protection of the source, course or feeders of a public stream, the disposal or control of storm water, the mitigation or prevention of soil erosion, and the conservation of water.

The Board may give written orders, if it considers such a course necessary, to any owner to undertake any measures it may consider desirable for the conservation of natural resources. These may relate to the depasturing of stock, the method of cultivation of the land, the prohibition and restriction of cultivation of any part of the land, and the control of water.

These far-reaching measures will, if enacted, protect not only the interests of posterity but the interests of genuine farmers, against ruthless exploitation. The fact that money spent on conservation is allowable for rebate purposes is a further indication of the national wish to safeguard what can never be replaced.

The measures are far-reaching, vital and in some respects revolutionary. All that the Government can do it has done. The rest lies with the farmer, who will remember that fertility depends not only on water and erosion control, but on organic matter and minerals. The soil too must be fed. The individual care of his soil, composting, adequate fertilising, afforestation, will repay the good farmer and build up something which can never be destroyed.

Sewage.

Many thousands of tons of fertiliser elements must be wasted each year in South Africa by the disposal of sewage and sewage effluents.

The Chinese have always been noted for the use to which they put human waste, and although the practice is very dangerous on account of intestinal parasites and disease-causing bacteria, it still continues.

A method, however, has now been devised by which these valuable materials may be safely utilised for the soil. Dr. Scharff, Chief Health Officer of Singapore, quoted in *The Farmers' Weekly*, has stated that, in Malaya, village refuse and night soil have been composted directly into humus by the Indore process.

Experiments were begun in Singapore in 1937 and have proceeded sufficiently to justify the statement that the treatment is simple, safe, economical and free from nuisance and that even fly breeding is abolished.

Preliminary work by the municipal bacteriologist of Singapore on sewage sludge proved that a temperature of 140 degrees Fahrenheit for half an hour destroyed all pathogenic organisms present, including the eggs of intestinal worms.

In the composting of village refuse and night soil a temperature of from 142-168 degrees Fahrenheit in the heaps was maintained for at least three weeks. As the compost was turned all pathogenic organisms were destroyed, and by the end of the third week the compost was free from intestinal worm eggs.

With increasing experience of the procedure smell was not found to be an objectional feature, and if care is taken there seems to be no reason why the method should not be widely adopted to conserve valuable fertiliser supplies.

Soil and Vegetation.

A recent paper by Milne in the *East African Agricultural Journal* emphasises what should be obvious to practical farmers, but is not generally realised, and that is that once the relationship existing between the soil and vegetation is changed by changing or removing the vegetation, then the soil no longer behaves as it did. One of the most common examples of this is with forest soils, although it applies in

all types of natural vegetation. It is perfectly well illustrated in the Vumba district, where under the natural vegetation, forest or scrub, the soil is dark, rich, friable and loamy. On adjacent land which has been ploughed and aerated the darkness and the loaminess have departed and there is a marked tendency to sandiness. This is due not only to the non-replacement of humus, but to the absence of shade, of bacteria, and of rooting systems which considerably affected the soil.

Milne says: "One function of the higher plants in the maintenance of a soil is admittedly to provide residues, whose substance after incorporation will have manurial and other ameliorative effects. Good enough substitutes can, however, often be found for these dead residues, and it is a mistake to regard the provision of them as the whole duty of plant life to the soil. Higher plants do not grow merely in or on the soil, any more than micro-organisms do. As participants in a working system they are of the soil, and if their living functions are checked or withheld for too long, as they are in circumstances of excessive grazing or too-prolonged continuance of arable cultivation, the soil reverts towards an inorganic condition in which, being 'dead,' it is at the mercy of disintegrating forces.

"If then the soil is to continue to grow plants for us, in turn we must grow plants for the soil."

The resting of soil for a period under grass is likely to restore to it some of the vitality it had under natural conditions.

Land Girls.

One of the features of the war that has passed so far without comment is the growing strength and efficiency of the Women's Land Army. The Women's Land Army already has more than 9,000 girls trained and at work. The girls are trained for at least a month on a farm or at an Institute and are given a choice of work when they are ready to start. They come from all over the British Isles and from all walks of

life; one of the best and most enthusiastic worked previously in a beauty parlour. Their work is not, as is often supposed, confined to the dairy. In addition to hand and machine milking, calf feeding, cleaning out and mixing rations, they do hedging and ditching, ploughing, poultry raising, market gardening and tractor driving. The praise showered on them by farmers and farmers' organisations is generous and sincere.

The land girls, particularly in Kent, have worked in constant danger, and have carried on in bombing raids and in storms of shrapnel from falling barrages. In this particularly dangerous area they merely applied for steel helmets and were issued with them. They are well called the Women's Land Army.

The Second Series Wheat Variety Trials at Rubenvale Farm, Umvuma.

The following note was submitted by the Agriculturist:

By the courtesy and co-operation of Mr. E. G. Raubenheimer these trials, commenced in 1933, were continued on unirrigated sandy vlei soil on his farm.

In the first variety trial (1934-37) the variety Punjab 8a headed the trial, and this variety has been included in the second trial commenced in 1938 in order to serve as a basis of comparison with nine other varieties.

The trial is designed in the form of 4 randomised blocks of 10 varieties.

During the current season the soil received a dressing of compost made from wheat straw bedding from the cow-byre, and in addition 300 lbs. of complete fertiliser.

The rate of seeding (broadcast) was 80 lbs. per acre for all varieties, and the seed was covered by disc-harrow.

The results of this trial for the three seasons 1938-40 are given below, the yields being in bags of 200 lbs. each per acre.

Variety.	1938.	1939.	1940.	Mean yield 3 years.
Punjab 8a	9.18	14.97	16.30	13.43
Sabanero	6.63	17.34	16.25	13.35
122 D.1.T.L.	9.35	14.52	13.30	12.33
B 256b 1.A.	7.90	14.56	14.65	12.33
Granadero Klein...	7.41	14.31	12.70	11.43
N.B. 230A......	9.07	12.29	13.75	11.65
58 F.L.1.	6.20	14.11	14.55	11.58
131C. 5P.	6.85	13.20	13.90	11.28
Renown	6.73	12.39	13.80	10.95
Florence	6.20	10.84	15.15	10.70
Mean yields	7.55	13.86	14.44	11.92
Standard error	0.77	0.86	0.64	0.47

The statistical analysis shows that the results are significant at the 1 per cent. point, and differences between mean yields of varieties of more than 3 times the standard error car be taken as significant.

It will be seen, therefore, on reference to the last column that over the three year period Punjab 8a and Sabanero have yielded significantly more than the other varieties, excepting 122 D.1.T.L. and B-256b. 1.A. The latter two varieties have significantly outyielded the varieties Florence and Renown.

Amount of Compost made by Farmers: Season 1939-40.

The Agriculturist has supplied the following figures which were compiled by the Government Statistician:—

District.	Cu. yards.
Wankie	10
Nyamandhlovu	2,650
Bulalima-Mangwe	878
Mtobo	1,755
Bulawayo	2,730
Bubi	4,270
Gwelo	10,157
Selukwe	1,220

District.	Cu. yards.
Insiza	2,038
Gwanda	50
Belingwe	1,000
Matabeleland	26,758
Victoria	1,388
Chilimanzi	3,541
Hartley	23,178
Lomagundi	17,223
Mazoe	22,046
Salisbury	35,732
Marandellas	6,921
Charter	536
Gutu	251
Ndanga	1,468
Melsetter	1,084
Umtali	4,354
Makoni	1,713
Inyanga	1,704
Mrewa	1,050
Darwin	10
Mashonaland	122,201
Southern Rhodesia	148,959

Number of farmers making compost ... 615

Largest quantities made by individuals: 4,320, 4,000, 3,000 cu. yards.

Agricultural Cleanliness by Law.

The following note is submitted by the Entomological Branch:—

Tobacco growers should acquaint themselves with the amendments made by Parliament last October to the Tobacco

Pest Suppression Act. Two of these changes call for observance at the present time, and both are based on the principle of agricultural cleanliness.

A last date will be fixed for the destruction in each year of crop refuse and alternate hosts of tobacco pests growing on cultivated land, but in addition to this it is now enacted that *at all times the remainder of the farm* must be kept free from living tobacco plants. It is an offence, therefore, to allow that sturdy tobacco plant growing near the wall of the grading shed, or on the roadside, to remain. Similarly, tobacco plants, including volunteers or re-growth, on old lands or elsewhere not "being grown in cultivated land for the production of the immediate season's crop," cause the owner to be committing an offence against the law by virtue of his failure to destroy such plants. There are, of course, exemptions, with which the average farmer is not concerned.

The second amendment requires the destruction, as soon as they are no longer required for planting, of any tobacco plants growing in seed-beds. The reasons for this are obvious:—*Cleanliness Aids Insect Control.*

Letters to the Editor

AGRICULTURAL ILLS AND SOME REMEDIES.

To the Editor, *The Rhodesia Agricultural Journal.*

Dear Sir,—Specialist maize growing has fallen on evil days. For twenty years at least there has been given to us a sign—a writing on the wall at frequent intervals—and only two of these warnings have been ignored.

Earlier and better ploughing, better stands, better seed selection, intelligent fertilising, green manuring, and even a slight rotation have come to stay. Field sanitation, to the extent of organised disposal of bye-products and trash and the handling and treatment of seed grain against insects and disease, is regarded with favour. Weeds, and especially witchweed, receive almost hysterical but ever less attention—less on account of the inability of growers to apply the accepted remedies and preventives effectively.

Soil conservation, mainly by means of contour ridges, has been eagerly preached by most, and the logical extension and completion of this branch of protection of soil may be expected to proceed.

Co-operative or controlled sales of produce have spread the cost of marketing on the just and the unjust alike.

Road transport has become cheaper and has increased the potential area of production.

A strong Maize Association came into being with the proposed objects of improving growing methods and protecting the interests of growers. When Rhodesia suddenly clashed with world markets on equal terms it found itself considerably outclassed. The Maize Association inclined itself to thoughts of bonus on exports and local control of markets, to the exclusion of consideration of means of reducing production costs and of scientific seed propagation. At that stage the Maize Association, in effect, died.

At about this time Mr. John Downie, an active and keen manager of the Farmers' Co-op., Ltd., had occasion to proceed to England in the interests of the maize growers. He did well in our interest, and also he saw the writing on the wall. He deduced that unless the maize grower of Rhodesia who sought to produce maize for the overseas market in fair competition with the rest of the world could do so for a return of about 6s. 3d. per bag he should get out of business as soon as possible. Mr. Mundy urged the Maize Association to approach the matter from the same point of view—reduction of costs.

This we ridiculed and finally ignored. The Maize Association held to its ideas of something for nothing and faded out. John Downie was right.

And at the present time the large-scale manufacture of compost is held to be almost the panacea. Most of the processes named have added considerably towards the improvement of production, but in spite of all economic production lags.

To-day, more than twenty years after the inception of the Maize Association, a body to urge the production of pedigreed and hybridised seed maize under Rhodesian conditions is being formed. It has a wonderful field before it.

Among the first problems it will have to investigate are the causes which reduced production in spite of the giant strides which have been taken in farming methods in the last two decades; and these investigations will have to be honest, meticulous and complete if they are to yield permanent results.

It is just here that I wish to sound a note of caution and, indeed, to make a big noise about it. The caution was sounded by Cameron in the very early days of the Agricultural Department. It was sounded later by Nobbs, Mundy, Walker and others, and recently by the technical officers of the various agricultural services, but not one has hurt his fist on the table trying to ram his point home. I refer to what we thought of long ago as soil impoverishment, later as sheet erosion, and now, to save ourselves from thinking we call water-logging.

At the outset let not the investigators think of this water-logging in terms of water. The effect is produced, under our

conditions, by a concentration of minute particles of soil or clay. The concentration is produced through years of almost constant clean cropping—a ploughing, cultivating and hoeing—exposing new soil to each successive beating rain which, in sinking into the soil, carries with it the finest of soil particles to the zone, probably untouched by the plough, where they come to rest by a process of filtering, forming an impervious bed. This bed limits the volume of soil explored by the roots of annuals and creates the impression of impoverishment. Later it shows as surface erosion by the simple process of causing greater rain water run-off, and now we see it as water-logging.

The process is inevitable where continuous clean cultivation is practised, even on the best managed farms where manure and compost are king. Nature hasn't a chance working against man in our climate—unless it clears him out first.

Long water-logging under natural conditions in the presence of iron produces superficial black or grey soils as in our vleis, with mousey soils on the edges.

Water-logging threw out vlei soils on some farms twenty years ago and these, where they did not go to dongas, returned to rich grasses. The same condition nowadays is often attributed to contour ridging, but investigation will almost invariably show this to be wrong.

The cure, we were told, was the addition of much humus and lime and the use of the subsoil plough. (Gardeners from time immemorial trenched and limed their soil.)

Owing to misapplication of these in the early days we had indifferent or inconsistent results, but I have not the slightest doubt that, correctly applied, these methods would help us now.

The result would, however, only be temporary.

What the maize grower needs now for the production of economic and disease-free crops from even the best of improved seed is new soil—a soil rejuvenated by *time*—time to renew the structure of the soil, obtainable by the use of so-called permanent crops which closely cover the soil, like paspalum

on the vlei soils, other suitable grasses on the transition mousey soils and long period legumes such as Kudzu Vine on the upland or red soils.

So much of the older maize producing areas are approaching the seemingly water-logged condition that the advantages of production of good seed, however necessary for other reasons, will be seriously offset by this one ill. The elimination of the water-logging condition too will help in the fight against witchweed and diplodia which now take so heavy a toll of the industry.

An examination of the details of this water-logging process would run into too long a screed. The present season is becoming too advanced for anything but immediate action —action in the way of establishing on each maize farm at least a nursery for paspalum and other vlei crops on the low ground and Kudzu vine on higher ground, with a view to the rapid establishment of permanent pastures before maize growers are forced out of business by their bulldog tenacity to obsolete methods.

The establishment of Kudzu is not for the faint hearted. It may please the greedier amongst us to be told that a well managed period of permanent pasture will renew the soil for a further rape such as one has witnessed during the past 20 years.

Kudzu and pasalum roots may be had from the Agricultural Department at a low rate and there are other sources of supply on various farms throughout the country. Go to it!—Yours, etc.,

THOS. J. MOSSOP.

Plumtree, 25th January, 1941.

How Does Compost Work?

By S. D. Timson, Assistant Agriculturist.

The attention of this branch of the Department has been directed to the letter signed "Farmer," which was published with the above title, in the January issue of *The Countryside*. In this letter "Farmer" raises the question of how compost exerts its beneficial effect on crops, and suggests that this is largely due to its nitrogen content, and he therefore enquires concerning the cheapest form of the latter available to farmers.

Despite the vast amount of research which has been focussed in recent years on the investigation of the composition and action of humus in the soil, and compost is essentially a form of humus, it is not possible for any one to answer categorically "Farmer's" queries, but the matter is discussed in this article from the point of view of the farmer, and it is hoped that these very brief notes on an extremely complex subject may be of assistance to him.

It can be said at once that compost does not merely supply nitrogen to the crop, but potash and phosphate also, and in quantities which are very considerable at the ordinary rates of application of this manure, namely, five to ten tons per acre. Moreover, these plant foods are in a readily available condition in properly made compost.

A normal well-made compost in Southern Rhodesia may be expected to contain approximately 0.8 per cent. of nitrogen, 0.4 per cent. of phosphoric oxide, 1.0 per cent. of potash, and 1.9 per cent. of calcium oxide (lime). When a dressing of 10 cubic yards (approximately 5 tons) per acre is applied to the soil, therefore, the equivalent of about 400 lbs. of sulphate of ammonia, of 200 lbs. of 20 per cent. superphosphate, of 206 lbs. of sulphate of potash, and of 190 lbs. of calcium oxide or approximately 350 lbs. of ground limestone, is added. It will be seen therefore that compost is a complete fertiliser, although it is an unbalanced one for most of our

farm crops, with the possible exception of some vegetables, since it is lacking in phosphate (compared with the nitrogen), which is still the principal plant food in which practically all our soils are very deficient, and it supplies comparatively large quantities of nitrogen to the soil. The actual nitrogen added to the soil in the compost is not the end of the story, however, since the organic matter, the lime and the phosphate in the compost all stimulate the activity of the free-living nitrogen-fixing bacteria in the soil, and these make further considerable quantities of nitrogen (obtained from the air) available to the crop.

There is no doubt that the main effect of an application of compost on, say, a crop of maize, *which is observable to the eye*, is the effect of the large nitrogen supply which is seen in the greatly increased growth of leaf and stem. This is to be expected from the analysis, of course, and from what we know by observation of the effect of a dressing of well-rotted kraal manure under favourable conditions, though the nitrogen in the latter is not so readily available as that in compost. However, the analysis shows that large quantities of phosphate and potash are also supplied by compost in a readily available form, and these will affect the growth of the crop and tend to counterbalance the tendency to an excess of nitrogen where large dressings of compost are applied. Evidence of this has repeatedly been seen in the past two or three years on farms where dressings of compost of from 7 to 14 tons per acre have been applied to maize without any additional phosphate or potash. Good yields of grain have been obtained despite the excess of nitrogen, and this could not be expected if dressings of nitrogen alone in the form of, say, sulphate of ammonia equivalent in quantity to the nitrogen in the compost had been applied without any phosphate or potash to balance it.

There is little doubt, however, that better yields of maize would have been obtained in these cases by the application of additional supplies of phosphate in the form of a suitable fertiliser, and perhaps (especially in the case of sandy soils) by additional supplies of potash, though this is unlikely, since the quantity contained in compost is large, as shown above.

Farmers can therefore be recommended to reinforce their dressings of compost applied to crops, by dressings of a suitable phosphatic fertiliser, on soils known to respond to phosphatic fertilisers. Experience on farms indicates that the normal dressing of phosphatic fertiliser can be economically reduced, where 5 to 8 tons of compost per acre are applied, but each farmer should test this for himself on his own fields. It is suggested that he should try reducing his dressing of phosphate to two-thirds, and then to a half of the normal one, and note the results.

That the effect of dressings of compost to crops is not due solely to the nitrogen it contains is indicated by the experiments of Jackson and Wad, where compost containing 110.2 lbs. of nitrogen was compared with sulphate of ammonia containing the same quantity of nitrogen, in its effect on the wheat crop. The wheat treated with compost yielded 1,829 lbs. of grain and 2,117 lbs. of straw per acre, whereas the wheat receiving sulphate of ammonia yielded 1,210 lbs. of grain and 1,472 lbs. of straw per acre.

The higher yields of wheat produced by the compost are doubtless due in part to the potash, phosphate and other minerals in the compost, and also to the important effects of the humus on the bacterial population of the soil, and the improvement in the crumb-structure or friability of the soil.

Compost (as also farmyard manure), is such a complex substance and some of its reactions on the soil and plant growth are so indirect, and so dependent on varying soil and climatic conditions, that it will never be possible to reduce its beneficial effects on crops to terms of nitrogen, phosphate and potash alone.

What the farmer requires to know is whether its action in the soil can be economically reinforced by additional phosphate, potash, or nitrogen in the form of fertilisers or in any other way. As already suggested, it can be usefully and economically reinforced with light dressings of phosphatic fertilisers, but except under exceptional circumstances it is unlikely that additional dressings of nitrogen or potash will be economic.

Now with regard to the suggestion by "Farmer" that experiments should be made to determine the cheapest way to supply a nitrogen deficiency in our soils, there can be little doubt that this can be most economically done by applying compost. On the basis of the analysis given above a 5 ton dressing per acre will supply nitrogen equivalent to 400 lbs. of sulphate of ammonia. From reliable costings of making compost we can now say with assurance that a 5 ton dressing of compost should not cost more than 7s. 6d. to make, and 1s. 8d. to cart and spread on an acre of land, a total of 9s. 2d. for native labour and rations. If we neglect the phosphate and potash in the compost and charge all the cost of making and spreading it to the nitrogen, the cost of the equivalent of 400 lbs. of sulphate of ammonia is 9s. 2d. spread on the land. The same dressing of nitrogen applied as sulphate of ammonia would cost in cash f.o.r. Salisbury at the pre-war price (£9 15s. 0d. per ton) approximately 39s., and at present prices (if it is obtainable) much more, actually £3 12s. 0d.

The green-manure crop is another cheap source of nitrogen, since the top growth of a well grown crop of sunnhemp when ploughed under will return to the soil about 210 lbs. of nitrogen per acre, or the equivalent of 1,050 lbs. (approximately) of sulphate of ammonia, at a cost of, say, 20s. per acre. The nitrogen contained in the root-system of the sunnhemp is an unknown factor, but we know from research in America that in the root system of a good velvet bean crop there is about 10 lbs. of nitrogen per acre, which is equivalent to about 50 lbs. of sulphate of ammonia. If this figure be taken for the nitrogen in the root system (it is sufficiently near for the present purpose), we arrive at a total nitrogen content of the sunnhemp crop of 220 lbs., which is equivalent to 1,100 lbs. of sulphate of ammonia. However, only two-thirds of this nitrogen (approximately) is obtained from the air through the agency of the legume bacteria, so the whole sunnhemp crop adds only some 146 lbs. of new nitrogen to the soil. This is equivalent to 733 lbs. of sulphate of ammonia. There is this great difference, however, between compost and fertilisers on the one hand, and the green manure crop on the other, namely, that land under green

manure is idle, in the sense that it is not producing a cash crop or one which can be converted into cash through the agency of stock.

It would appear to be fair therefore to charge to the green manure crop as a source of nitrogen the profit, which might be expected from a cash crop, which might have been grown on the land occupied by the green manure.

Land which would normally be green manured in the maize belt may be expected to produce 8 bags an acre, and the profit per bag may be taken to be 2s. 6d. Therefore the sum of 20s. is to be added to the cost of producing and ploughing under the sunnhemp (20s. per acre), making the total cost of producing nitrogen equivalent to 733 lbs. of sulphate of ammonia at 40s., or approximately 21s. 9d. for nitrogen equivalent to 400 lbs. of sulphate of ammonia, our basis of comparison with compost.

We finally arrive at the cost of supplying to the soil 80 lbs. of nitrogen, or its approximate equivalent of 400 lbs. of sulphate of ammonia, to be 9s. 2d. as compost; 21s. 9d. in the form of sunnhemp ploughed in, and 72s. as sulphate of ammonia at present prices, or 39s. at pre-war prices of this fertiliser.

Of course, all the nitrogen in compost or in green-manures is not available to crops in the year of application, since a proportion remains bound up in the humus until the following year, but we are concerned at the moment with the cheapest source of nitrogen on the farm, and it is clear from the above facts that the nitrogen in compost and green-manures is very much cheaper than that in the cheapest artificial fertiliser source of nitrogen.

The subject has been pursued at some length as it is considered desirable once again to emphasise the fact that the nitrogen supply for the soil should be produced on the farm as far as this is possible, since it is a very expensive item to purchase in the form of fertiliser. The estimates given above illustrate in a practical form how much cheaper it is for the farmer to manufacture his own supplies of nitrogen on the farm rather than purchase it in the form of artificial fertiliser.

Of course, this is not the whole story of nitrogen supply on the farm by a long way, since there are occasions when only a nitrogenous fertiliser, alone or, perhaps, in combination with green manure or compost (as in growing potatoes) can be used, particularly in the case of the tobacco crop, and in top-dressing pastures, or crops temporarily suffering from nitrogen-starvation. Nevertheless, if the farmer properly maintains the nitrogen supply in his soil by green-manuring, by applying compost, and by ploughing under the stubble of legumes and grass hay crops, he will seldom require to purchase nitrogenous manures, for he will in those ways maintain the humus content of his soil, and it must be remembered that the humus in the soil is the source of all the nitrogen consumed by crops, except where it is added to the soil in the form of inorganic fertilisers.

It should be mentioned here that maize has not given an economical response to nitrogenous fertilisers in experiments carried out at the Salisbury Experiment Station during the seasons 1929-30 and 1930-31. In the former year nitrate of soda was applied at the rate of 75 lbs. per acre and 150 lbs. per acre in the drills when the seed was sown, and at 75 lbs. per acre broadcast when the maize was between 6 and 7 inches high. No beneficial effect on the yield of maize was recorded.

In 1930-31 a top-dressing of 100 lbs. of nitrate of soda per acre was applied along the rows of plants (*a*) when they were 12 to 24 inches high; (*b*) when the plants were near the flowering stage; (*c*) from the time when the maize was 12 inches high in weekly applications of 25 lbs. each. The cost of 100 lbs. of nitrate of soda at that time was 16s. (it is now 16s. 6d.). In this experiment increases in yield of maize over the control were for the three methods of application as follows—(*a*) 0.72 bags per acre; (*b*) 1.74 bags; (*c*) 1.85 bags per acre. These increases, however, were not statistically significant and may therefore have been due to chance. Even the greatest increase in yield (1.85 bags per acre) was not profitable.

In both experiments a basic dressing of 400 lbs. of potassic superphosphate per acre was applied during preparation of the soil in order to ensure that a lack of either potash or phosphate should not interfere with the response of the

maize to nitrogen. Furthermore, at the Potchefstroom School of Agriculture no significant response by maize to applications before planting of 100 lbs. of sulphate of ammonia, or of 133 lbs. per acre of nitrate of soda, since the experiment was commenced in 1932, either in the form of increases in yield of grain or of stover, was shown. A basic dressing of 200 lbs. per acre of superphosphate is applied annually.

With regard to "Farmer's" suggestion that the effect of the method of applying compost to the soil might affect its value, this is being investigated on the Witchweed Demonstration Farm near Whitecliffe. The indications at present are that covering the compost by ploughing is more beneficial to the maize crop than covering by disc-harrow, as evidenced by the considerably stronger growth and darker green colour of the maize, where the compost was ploughed in. Farmers are advised to try this simple experiment in order to obtain information concerning the matter under their own conditions of soil and climate.

The very important beneficial effect of compost, green manure, or kraal manure, on the crumb structure or friability of the soil, since this is largely due to their humus content, must necessarily be only temporary since humus in the soil is continually being destroyed in arable land in this Colony by the action of micro-organisms. This is especially true of our soils, since the high soil temperatures increase the activity of these organisms. The work of Mohr has demonstrated that humus will not accumulate in well-drained soils when the average temperature is 77° Fahrenheit or higher, as is usually the case in this Colony during the summer months of October to April. It is probable, too, that destruction of humus in the surface soil during the winter months is furthered by other agencies, including the action of sunlight.

For these reasons the farmer in this Colony must face the necessity of continually replenishing the supply of humus in the soil by green-manuring, compost, kraal manure, and the stubbles of legumes and other annual hay crops. The great efficiency of temporary grass leys in restoring the crumb structure and humus content of the soil has been demonstrated in other countries throughout the world and is under investigation here, and should be borne in mind. If the farmer

maintains the humus supply of his soil in these ways he will automatically maintain the nitrogen supply at the same time, since humus is the only sources of nitrogen in the soil for plant growth, except where it is added in the form of inorganic fertilisers.

A good humus supply in the soil, secured by the methods indicated above, will also normally ensure a good supply of potash, but the farmer will always need to maintain the phosphate supply in the soil by the addition of phosphates, excepting only, perhaps, in the case of certain heavy black soils, on which dressings of phosphate have not proved effective in Matabeleland.

It is possible that the mycorrhizal association with the roots of our crops may prove to be an important factor in the success of compost. Roots of maize grown on land dressed with compost on the Witchweed Demonstration Farm last season were forwarded to Sir Albert Howard, and were found by the leading authority on the subject to be thoroughly permeated with mycorrhizal hyphae. The mycorrhizal association has been proved by this Department to be essential to the successful culture of certain pine trees in this Colony.

It is also possible that part of the beneficial effect of compost may be ascribed to the action of certain plant-stimulating and growth-regulating substances known as Hormones, which are akin in their action on plant growth to vitamins in the food of man, but this is not sufficiently established at present to be accepted without reserve.

Much research has been directed in recent years to the "deficiency diseases" of crops, due to the absence or deficiency in some soils of the rarer elements such as boron, copper, zinc, and manganese. In a number of cases these diseases have been cured by applications of compost or farmyard manure, which contain most of these rarer elements in minute, but sufficient quantities. A boron deficiency disease of oranges has recently been demonstrated on the Mazoe Citrus Estate.

It may perhaps be claimed that sufficient has been said to indicate the intricacy of the problem "How does compost work?" It is such a vast subject that despite the tremendous amount of research which has been devoted to it in recent

years it is certain that this question cannot be answered in full for many generations, if ever. Nevertheless, the farmer can remain assured that he has in compost a valuable and cheap source of fertility for his soils, which normally requires reinforcement only with comparatively small additions of phosphate to make it suitable for use for all our principal farm crops.

That some 615 of our farmers have made, during the past year, nearly 150,000 cubic yards of compost is sufficient evidence that its value is being widely appreciated. And the fact that individual farmers have made such large quantities during the year as 4,320, 4,000 and 3,000 cubic yards respectively indicates that it is cheap to make, and this is supported by accurate costings which are now available.

In conclusion, the opportunity may be taken to correct "Farmer's" statement that an officer of this Branch, during an address to a farmers' meeting at Glendale, "admitted that as a result of his experiments the application of phosphates gave increases above the cost of fertiliser only when a complete green crop was returned to the land."

The divorcing from its context of this gentleman's statement as quoted by "Farmer" misrepresents his meaning. He was endeavouring to illustrate from the results obtained in one recent experiment, a fact of great importance to the maize farmer, which has been demonstrated by other experiments carried out on the Salisbury Experiment Station over a long period of years. This is that the application of phosphate to maize on soil depleted of humus does not give profitable increases in the yield of maize.

Veterinary Notes

(*A*)—A SIMPLE TREATMENT FOR RETAINED AFTERBIRTH AND SEPSIS RESULTING THEREFROM.

(*B*)—A NOTE ON THE USE OF MOTOR OIL AS AN EMERGENCY ASSISTANT IN THE CALVING OF COWS.

By T. L. May, M.R.C.V.S.

(*A*)—The following cheap and handy substitute for the treatment of retained afterbirth and the complications resulting therefrom, was found to be effective in the case of a cattle ranch where European control was limited, by necessity, to a weekly inspection.

It has the advantage of being practically foolproof, and the treatment can be undertaken by a capable and intelligent native.

It has given satisfactory results both in keeping sepsis under control and in stimulating the early expulsion of the afterbirth.

Method of Preparation and Use.—A piece of butter muslin one foot square is spread flat and two full handfuls of ordinary coarse dairy salt are placed towards the centre of it. The edges of the muslin are then gathered together on top of the salt and a bag is thereby formed. A two-foot length of one-inch bandage, or tape, is procured, and the mouth of the bag firmly tied with one end of the tape.

The operator's hand and arm should be washed and well soaped, or preferably smeared over with vaseline, and the closed salt pack introduced into the mouth of the womb, and placed well back into the womb.

The other end of the tape is kept outside the animal and tied on to a smooth 6 inch length of cane, resting against and across the external opening of the genital passage.

The pack is removed from the cow after two days by simply exerting gentle extraction on the piece of cane, when the empty pack is retrieved.

In practice it has been found that the pack has been generally expelled along with the afterbirth after two days.

If a septic discharge is still persistent, a similar but smaller pack may be reinserted for a further two days.

Owing to the risk of infection to the operator through abrasions of the skin, it is important that the hands and arms be thoroughly disinfected immediately after the operation.

(*B*)—It is a frequent occurrence in this Colony—particularly during the dry season, when animals are in low condition—for an animal to stray into the veld in an effort to calve.

In such circumstances the animal, when found, is usually exhausted, the calf probably dead, and with the natural lubricating secretions necessary for easy calving greatly reduced, or absent.

It has been found that the most effective and lasting lubrication, with no harmful effects, is a half gallon of fresh, clean motor oil, introduced by means of a clean length of two-inch hose pipe and a wide-mouthed funnel. The funnel should be held well above the cow's hindquarters with the hose inserted as far in the passage as possible on top of the calf, the end of the hose being gently worked backwards and forwards. At least fifteen minutes should be allowed for the oil to gravitate into the passage; further spreading of the oil by hand over the calf can usually be performed before traction is applied.

If possible, it is an advantage to heat the oil to body heat before its introduction, and to immerse the funnel and hose in hot water.

Who built the first Contour Ridges?

By D. AYLEN, Irrigation Department.

Whether or not the Inyanga terraces are linked with Zimbabwe and other ancient ruins scattered over Rhodesia, it is not the purpose of this article to advance any arguments on the controversy. Terraces, however, are found in close proximity to the so-called "slave-pits," and must be considered associated with those ruins.

Before describing some of the different forms of Inyanga terraces it would be as well to say something about primitive terracing systems elsewhere. Incidentally by primitive it is not meant that the terraces are lacking in any quality of design, or that they do not satisfactorily perform their intended purpose, but rather that they were built by primitive means and even primitive people.

Abandoned terrace systems are not unique to Rhodesia and may be found as far apart as the hinterland of China and Central America. In fact, a few terraces may even be found on the slopes below ancient British earthworks on the chalk downs of Wiltshire. Similar terraces are still in use in many countries.

It is therefore obvious that early civilisations, and even primitive peoples, as soon as they took up intensive agriculture brought about perhaps through expansion of population, scarcity of suitable land, use of irrigation or a need to defend their crops against marauders, found that erosion took place, and as a result each centre gradually evolved a system of soil conservation.

This eventually took the form of what we term "bench" terraces. Naturally the actual design and size varied from country to country, but not as much as might be expected. The ultimate design naturally would vary slightly according to the crop grown and whether irrigated or not. With rice,

for example, an attempt would be made to collect all the rain water in shallow ponds. The degree of slope of the land would also result in modifications.

Our modern contour ridge is a modification of terracing designed to enable the use of modern farm machinery. When land was cultivated by primitive hand implements, the width of the terrace strip was of little importance. To-day we require a wider strip when field crops are to be planted, in order to provide a reasonable working space for our machinery; however, the ancient system of bench type terraces is still found most satisfactory for irrigation purposes or for market garden crops and orchards.

Inyanga terraces can be found from some way north of Rusape to just south of Penhalonga and well into Portuguese territory. Though, as stated earlier in this article, a stereotyped design was eventually evolved in most other cases, this may or may not be true of the Inyanga terraces, as they vary considerably in design, shape and method of construction.

Alternatively perhaps they show examples of all stages of evolution, but it is more than likely that different needs and purposes and the presence or absence of stone resulted in different designs and what we can see is evolution of several different kinds, each best suited to certain peculiar needs and circumstances.

The first terraces which the tourist sees, but usually fails to take for what they are, have actually been used as a site for the Rhodes Hotel, the buildings behind it and the garden. There are further terraces in the orchard below the road which continue into the paddock. The steep slope between the orchard and the river shows the remains of many stone faced terraces. The ample and constant stream which supplies water to the hotel is brought by an ancient furrow several miles long.

The large earth terraces in the orchard and paddock appear to have resulted from the practice known as strip cropping over a long period. That is when the land was cultivated, strips of grass were left on the contour at intervals down the slope, and though severe erosion was prevented, sufficient soil was washed down as far as the grass strip and

held there to gradually raise the level and eventually form terraces. A similar result, but not so marked, has come about where strips of grass have been left in the cultivated fields of Western Virginia.

Though this practice has been in use in Western Virginia for more than 100 years, it is impossible to even guess how long it would take to form the Rhodes Hotel terraces, as climates and soils differ greatly and undoubtedly irrigation was practised in the latter case.

Longer and better preserved stone-faced terraces may be found just beyond the "slave pits" on the rise opposite the hotel. There are also short lengths of an irrigation furrow.

About half way to Inyangombie Falls, the road passes through some native lands. These have been recently contour-ridged, but careful observation shows that this slope had already similar but smaller sized terraces to those at the hotel. The modern contour ridges and the ancient terraces take exactly parallel courses.

The distant slopes to the west of the main Umtali-Inyanga road between the circular drive and Pungwe Falls View turn-offs, are all terraced. However, a knoll in the valley below the road has, besides terraces, what also appears to be defensive earthworks.

The terraces here are reminiscent of the Georgia terraces in America, though unlike the Georgia terraces they have not broken. The Georgia terraces were built as banks rather like contour ridges before the Civil War with slave labour. However, being too widely spaced and owing to the neglect of rotations, the soil moved down the slope partially terracing the land, necessitating yearly raising of the bank. Complete neglect in later years resulted in their failure.

The Pungwe Gorge shows evidence of all land suitable to agriculture having been terraced. Unfortunately during recent years squatters on the right bank have destroyed most of the terraces on that site.

One of the most interesting places is just behind the Iron Cliffs. Here are to be seen two irrigation furrows and every type of earth terrace from bench terraces, well suited

for irrigation, and rice terraces not irrigated, to modern type contour ridges. Further earthworks are purely defensive. All these works are almost identical to the various modern types.

A further point of interest is that the strips between some very modern looking contour ridges have been sub-divided by low banks at right angles to the ridges, evidently to mark off individual plots.

Whilst most of the soil conservation works have not been set out with a greater degree of accuracy than would be just possible by the naked eye, the irrigation furrows compare most favourably with modern ones set out by engineers' instruments.

The contour ridge is presumed to be a recent innovation, perhaps 70 years old at the most, though irrigation and bench and rice terracing have been practised in other parts of the world for 4,000 years; but here we have examples of contour ridges made by an unknown people. Probably nowhere else are disused terrace systems found in such a good state of preservation. Though many examples have been damaged by later cultivation and weathering, particularly the stone faced terraces, many are almost perfect. Some stone work was evidently haphazard and utilised mainly as a means of disposing of stone; this work has crumbled badly, but in other cases well laid walls, which are still standing almost in entirety, must have been built before cultivation commenced.

One striking fact is that certain most elaborate and modern looking terraces appear to have been scarcely used, whilst other types appear to have been evolved by contour methods of working the land.

The cause of the Inyanga gullies is as yet unknown. All one can say is that recently some have been aggravated by native cultivation, that some were in existence before the terraces were made, and in a few cases, breaks in the ancient furrows may have caused certain of the gullies. Further south along the Eastern Border one can see terraces of huge gullies so old that they have almost been rounded off to form part of the landscape, leading one to believe that the growth

of gullies and their eventual stabilisation and gradual dissolution into the terrain is here a natural process, taking thousands of years to complete the cycle.

One must therefore consider this district is prone to the formation of immense gullies from small causes, and extra care should be taken because from slight causes the gullies go on until they reach rock or the mountain tops, destroying huge areas which only recover during a period which must be expressed in geological terms of time.

Who built the terraces is at present as great a mystery as Zimbabwe or the other ruins in Rhodesia. It is also rather puzzling as to why this plateau, and in fact most of the Eastern Border, is almost treeless. As a rule trees do well, and a body of scientists who examined the botany of the area a few years ago came to the conclusion that at a comparatively recent date it was wooded. There is no doubt that planted trees do well.

These mysteries may be interlocked or they may be completely disassociated, but as yet none has received adequate attention. It is sufficient to say here that we have complete evidence that some early people or other practised soil conservation with a high degree of efficiency and in one form or another applied it generally to all their lands: a stage which is still a long way from being reached in modern Rhodesia.

Opportunities for agricultural cleanliness are always at hand.

Cleanliness Aids Insect Control.

On Tropical Sunshine

By W. K. Blackie, M.D., Ph.D., M.R.C.P. (Edin.), D.T.M. & H.

Man is, by nature, a child of the sun. He has worshipped it with all the fear and abandon of the primitive mind, he has praised it in song and in verse and has wrestled to record in colour the transforming magic of its rays. Nor has the march of time significantly modified our fundamental responses, hence there exists in each and every one of us that primeval instinct which welcomes the joys of unrestricted sunshine without counting the cost, and those of us whose road in life has led from the grey skies and mists of the homeland to this land of sunshine can vividly recall the rapid, spontaneous and enthusiastic reversion to the cult of sun-worshipping.

Obviously there is nothing pathological in this urge to bask in the sunshine, none the less there is in it that element of mob reaction which lulls critical analysis. In my own case a deeper interest in tropical sunshine was aroused by the chance remark of a medical man who had spent many years in the tropics. While discussing the hazards that attend residence in the tropics he happened to say: "You must always remember one thing—in England the sun is your friend, but here in Rhodesia the sun is your enemy." It was indeed startling to encounter this esoteric doctrine in a country of sun-worshippers, but it served to stimulate a more critical attitude towards the influence of tropical sunshine on the white-skinned races.

Strangely enough my first essay in the study of tropical sunshine appeared to refute my colleague's dictum in that it revealed an important measure of natural control which protected man against an insidious parasitic invader. Thus while engaged in the study of hookworm disease it was soon apparent that the incidence of the disease was much lower, and therefore contrasted sharply, with its incidence in the moister regions of the tropics.

It was then readily demonstrated by simple experiment that while hookworm was being introduced into the country by a steady stream of heavily parasitized immigrant natives it failed to establish itself amongst the indigenous population to any significant extent. The primary reason for this phenomenon was found to be in the lethal action of the solar rays on the parasite during the extra-corporeal phase of its life cycle. This constitutes but one example of the "protective action" of the tropical sunshine, but it must be pointed out this use of the term "protective action" implies a homocentric viewpoint, since the protection is conditioned by the destructive action of the sun's rays on inadequately protected protoplasm. It may be said, however, that all the protoplasm has its "place in the sun" or, alternatively, that nature has adapted protoplasm to its optimum or natural environment so that the hazards of survival are reduced to a minimum. The corollary therefore is that the translation of protoplasm to a "foreign" environment must in the nature of things imperil its chances of survival, even allowing for the faculty of adaptation.

It must, I think, be accepted that the European resident in the tropics is living outside his natural environment, since we cannot ignore the obvious fact that races indigenous to the tropics are equipped with a highly specialised cutaneous pigmentary layer designed to protect them against the deleterious effects of the solar rays. Again, additional protection is provided by the less well known property of fluorescence, which is conferred upon the negroid skin by reason of the facile secretion of sebum and oily sweat. By way of contrast not only is the skin of the European inadequately fluorescent but it is devoid of a protective pigmentation, hence the reason for the severe sunburn which rapidly develops on exposure to tropical sunshine. The skin, of course, does all it can to adapt itself to the traumatising action of the solar rays and by means of bronzing or freckling it partially succeeds in decreasing its sensitivity. But the price to be paid is but imperfectly appreciated, although the change in texture is well enough known. Thus the skin becomes dry, harsh and hairy and in due course acquires the distinctive characters of "tropical skin." When it is remembered that the skin fulfils important functions in regard to secretion, excretion,

heat regulation and the like it is obvious that any widespread atrophy of the skin must have more far-reaching consequences than we are yet aware of.

Of even greater importance, however, is the influence of the tropical sun on the nervous system of the European. When combined with great heat the rays produce the sharply defined, rather dramatic condition commonly designated sun-stroke. In such circumstances everyone is duly impressed by the amazing power of the tropical sun on the inadequately protected victim. On the other hand there is a group of symptoms attributable to the direct action of the actinic rays which not only receive the most cursory attention in monographs on tropical medicine but are frequently regarded by the layman as the inevitable consequence of life in the tropics. The mechanism underlying the production of these symptoms has been carefully worked out on an experimental basis and it has been shown that exposure of the head to the direct rays of the tropical sun promotes congestion of the blood vessels which ramify in the delicate coverings of the brain—a condition technically known as "meningeal congestion." In addition the brain tissues themselves are rendered hypersensitive to normal stimuli. In its acute form these changes are reflected in intense headache, intolerance of sound, light and movement, with vomitting, fever and even delirium. Fortunately, however, the delicate tissues of the human brain have remarkable recuperative powers, hence in favourable circumstances the congestive reactions described subside without leaving any permanent injury. On the other hand repeated exposure of the head to direct tropical sunshine induces morbid changes of a permanent nature in the underlying brain tissue, and it is from such changes that the symptom complex designated "suntraumatism" takes origin. It must be admitted that the problem of sun-traumatism has not yet been studied in sufficient detail to enable one to give a comprehensive analysis of the condition, hence only the more salient features will be discussed.

As might be expected headache constitutes one of the commonest complaints amongst Europeans in the tropics. Obviously headache may be due to many causes, but there can be little doubt that sun-traumatism plays an important

role in its causation. While it cannot be claimed that the presenting features of sun-headache differ fundamentally from those of headache due to other causes, it can be said that its main component is a feeling of pressure or tension inside the head which is not only difficult to tolerate but is often exceedingly difficult to treat.

Closely linked with sun-headache is a state of chronic irritability which manifests itself in a tendency to be upset over trifles and to resort to hasty and ill-considered speech. Thus the soft answer which turneth away wrath is seldom heard on the lips of the victim of sun-traumatism who is still further stigmatized by his ill-starred faculty for creating disharmony wherever he goes. Associated with this state of chronic irritability is a curious lack of self control which finds such ample scope for self expression in this mechanical age.

In the intellectual sphere the outstanding features of sun-traumatism are impaired memory and lack of concentration, which as frequently as not cause the patient a minimum of concern. It would appear therefore that there is an associated lack of insight into the mental process which in its more exaggerated forms assumes the characters of frank negativism. The whole tendency therefore is towards a general lowering of the intellectual standard—a shrinking away from sustained mental exertion with dulling of the critical faculty and a dimming of the pioneer spirit in the realm of thought. When it is remembered that the intellectual traditions of this young Colony are still in the making it is clear that no effort should be spared to lay the menacing spectre of sun-traumatism.

As already stated, this symptom complex has not yet been fully explored in all its ramifications, but enough has been said to illustrate the deleterious action of the sun's rays on the skin and brain of the European in the tropics. While it is possible that some degree of tolerance to the rays may be acquired in adults it is unlikely that tolerance will be gained with impunity, and if in adults a price has to be paid how much greater must be the price in children whose delicate skin, thin scalp and previous bones render them especially vulnerable to the powerful, destructive and relentless solar rays.

It has been said that England's battles have been won on the playing fields of Eton, but paradoxical as it may seem I fear that it can be said with even greater truth that the physical and intellectual future of Rhodesia is being seriously jeopardised on the playing fields and in the parks of our Colony.

THIS LITTLE WEEVIL.

No explanation has ever been given why a certain little pig went to market, nor have the surprisingly varied activities of his four, small, individually-indicated contemporaries been explained. In the modern version we take you into our confidence and unobtrusively interpolate, both in parentheses and in prose, a little more detail in elucidation of the activities of the digital heroes of the rhyme. Here it is:—

This little weevil went to market
(And started a new infestation there),
This little weevil stayed at home
(And increased the local infestation),
This little weevil ate spilled maize
(Because kindly rats had eaten holes into the bags);
This little weevil had none
(Because the maize was in bulk storage safe from rats, and the weevil couldn't get in);
And *this* little weevil cried "Wee, Wee, Weevil" all the way home
(Because the lands had been cleaned up so well that there was nothing to eat on the way).

Moral:—*Cleanliness Aids Insect Control.*

A Substitute for Corrugated Iron

By C. WALKER, Instructor in Agriculture, Thames.

Many farmers will be concerned at the shortage of roofing iron during the present emergency, and the following suggestion is offered as a useful temporary substitute.

On many farms small sheds, either for poultry, implements, hay, or some other purpose, are occasionally required at short notice. These can be built from short ends of timber, which provide the framework, and covered by superphosphate bags drawn tightly over this framework and treated as follows:—

Procure the listed materials in the proportions given.

Cement	12 lb.
Salt	1 lb.
Lime	2 lb.
Alum	½ lb.
Bluestone	4 oz.
Water	1¼ gallons.

Sieve the salt and lime through a fine mesh sieve to destroy lumps and remove any pieces of rock. Add the water slowly, keeping the mixture stirred. Then add the cement, and stir thoroughly during the process. The alum and half the bluestone are finally added, and the whole mixture well stirred.

Take the remaining bluestone and dissolve it in 1¼ gallons of fresh water. With this solution, thoroughly wet the sacking, using a whitewash brush. The mixture should then be quickly applied to the outside, then the inside, and finally to the outside again before the first coat has dried.

Sheds so treated are quite waterproof, and the bluestone greatly lengthens the life of the sacking. Moreover, as the sacking shrinks with the dressing, it assumes quite an attractive appearance, which may be intensified by adding pigment to the mixture. Any pigment such as used in concrete floors would suit.

In the Tauranga district sheds of this type have been known to give useful service for a number of years.

In order to assess the quantities required for any shed, after the sacking has been placed in position, thoroughly wet it with fresh water. Should this take 2½ gallons, one would realise that double the listed quantities would be required. Similarly, if 5 gallons were needed, four times the quantities of lime, salt, cement, alum, and bluestone would be required. —*New Zealand Journal of Agriculture*.

Cleanliness Aids Insect Control.

Rhodesian Milk Records.

SEMI-OFFICIAL.

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B Fat in llbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Billie Boy	G. Friesland	9249 70	302.41	3.27	300	J A. Baxter, Glen Norah, P.O. Box 1040, Salisbury.
Bisland	G. Friesland	9392.40	391.63	4.17	280	
Black	G. Friesland	9881.10	325.99	3.30	300	
Blue	G. Friesland	11670.30	397.74	3.41	300	
Boxing Day	G. Friesland	6403 30	277.27	4.33	300	
Boyce	G. Friesland	7509 10	251 15	3 34	300	
Brandy	G. Friesland	10991.50	397.02	3.61	300	
Bud III.	G. Jersey	8312 80	313 79	3.78	300	
Bulawayo II.	G. Friesland	6730.60	246.43	3 66	300	
Clacupar Penelope Titus	P.B. Friesland	9040.90	335.67	3.71	300	
Dongera	G. Friesland	6690.70	266 66	4.00	243	
Frieda II.	G. Friesland	7876.00	307 69	3.91	300	
Government	G. Shorthorn	7248 30	284.79	3.93	300	
Joy	G Friesland	8191.90	244.25	2.98	300	
Lesboy	G. Friesland	7883 30	278.14	3.53	300	
Madjuma	G. Friesland	6823.20	300.71	4 41	300	
Makwira	G. Friesland	10514.10	381.24	3.63	300	
Mazoe	G. Friesland	7374 40	301.96	4.10	300	
Notso	G. Friesland	8882.10	326 46	3.68	300	
Ponto	G. Friesland	8207 50	258 34	3 15	300	
Pula	G. Friesland	7112.90	277.67	3.90	306	
Red Jessie	G. Friesland	7932 10	311 70	3.93	292	
Saturday	G. Friesland	7224 50	262 55	3 63	300	
Skami-Leg	G. Friesland	7143 90	259.54	3.63	300	
Taguta	G. Friesland	7660 40	307 83	4.02	300	
Charleston Effy II.	P.B. Friesland	11960.30	347 28	2 90	300	Bluffhill Dairy, P.O. Box 346, Salisbury
Duchess	G. Friesland	6026.20	212 11	3 52	300	T. Cousins, Oaklands, Gwelo.
Opal	G. Friesland	6048.30	209 08	3.46	297	
Pixie	G. Friesland	5861.00	238.92	4.08	276	
Rosebud	G. Friesland	8216 70	284 42	3 46	300	
Rosemary	G. Friesland	9077 90	331 23	3.65	295	
No. 132	G. Friesland	5627.20	242.08	4.30	284	H. A. Day, Stoneridge, P.O. Box 1153, Salisbury.

RHODESIAN MILK RECORDS.

SEMI-OFFICIAL.—(Continued).

Peach	G. Friesland	6187.70	248.02	4.01	279	P. Freeland, Lingfield, Gwelo.
No. 38	G. Friesland	6181.40	237.95	3.85	300	
No. 40	G. Friesland	5810.20	205.57	3.54	300	
No. 41	G. Friesland	5291.60	214.17	4.05	300	
No. 42	G. Friesland	6764.40	223.67	3.31	300	
Gowerhill Amaryllis	G. Friesland	7139.00	259.31	3.63	241	Gowerhill Dairy, P.O. Box 1143, Salisbury.
Mahom	G. Friesland	6656.90	228.99	3.44	300	
Merle	G. Friesland	8641.60	331.16	3.83	300	
Ounooi I.	G. Friesland	6881.70	267.22	3.88	300	D. J. Huddy, Granville, P.O. Box 899, Salisbury.
Peach	G. Shorthorn	8010.30	252.54	3.15	300	Mazoe Citrus Est., P.O. Mazoe.
No. 39	G. Friesland	7099.00	220.71	3.11	300	
No. 164	G. Friesland	11044.00	374.91	3.39	300	Meikle Bros., Leachdale, Shangani.
No. 368	P.B. Friesland	69[illegible]9.00	233.96	3.37	300	
Maud	G. Friesland	9112.00	285.75	3.14	300	F. B. Morrisby, Sunnyside, Gwelo.
Regina	G. Friesland	7728.00	281.40	3.64	300	
Victoria	G. Friesland	7191.00	228.53	3.18	300	
No. 43	G. Friesland	7030.00	242.63	3.45	300	
No. 49	G. Friesland	6600.00	226.31	3.43	300	
No. 70	G. Friesland	6502.00	224.98	3.46	300	
No. 63	G. Ayrshire	5954.00	235.45	3.95	283	Rhodes Matopo Est., P.B. 19K., Bulawayo.
No. 101	G. Red Poll	5371.50	207.61	3.87	300	
Leman	G. Friesland	6278.40	257.25	4.10	300	W. F. H. Scutt, Maple Leaf, Norton.
Milika	G. Friesland	7464.30	288.01	3.86	300	
Nellie	G. Friesland	6914.30	244.65	3.54	300	W. Sole, Buahinia, Glendale.
Pansy	G. Friesland	8395.40	305.02	3.64	300	
Carmen of Delectus	P.B. Guernsey	7865.90	384.30	4.89	300	A. Stokes, Safago, Gwelo.
No. 19	G. Friesland	6379.40	261.26	4.10	277	
No. 122	G. Friesland	7810.00	247.65	3.17	280	
No. 209	G. Friesland	5503.70	278.47	5.06	300	
No. 222	G. Friesland	8466.10	315.85	3.73	277	

RHODESIAN MILK RECORDS.

OFFICIAL.

Name of Cow.	Breed	Milk in lbs	B Fat in lbs.	Average % B. Fat.	*No. of Days.	Name and Address of Owner.
Matopo Kirton Sylvia, 5.9.1930	Red Poll	4572.40	198.67	4.34	253	Rhodes Matopo Estate, P.B. 19K., Bulawayo.

Southern Rhodesia Veterinary Report.

JANUARY, 1941.

DISEASES.

Anthrax was diagnosed on Ngomahuru Leper Settlement, in the Victoria district, and Chibi Native Reserve, Chibi district.

African Coast Fever was diagnosed on farm Brooklyn, in the Salisbury Native District.

TUBERCULIN TEST.

Thirteen bulls, forty cows and calves and nine heifers were tested on importation. There were no reactors.

MALLEIN TEST.

Eight horses were tested with negative results.

IMPORTATIONS.

From Union of South Africa.—Bulls, 12; cows and calves, 6; heifers, 9; horses, 8; sheep, 1,152; pigs, 10.

From South-West Africa.—Bulls, 1; cows and calves, 34.

From Bechuanaland Protectorate.—Sheep and goats, 295.

From Northern Rhodesia.—Pigs, 1.

EXPORTATIONS.

To Portuguese East Africa.—Slaughter cattle, 72; sheep, 50.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

To United Kingdom.—Beef quarters (chilled quality), 5,171; tongues, 2,706 lbs.; livers, 20,047 lbs.; tails, 3,760 lbs.; skirts, 1,112 lbs.; tongue roots, 2,002 lbs.

To Northern Rhodesia.—Beef carcases, 177; offal, 8,560 lbs.

To Belgian Congo.—Beef carcases, 39; mutton carcases, 6; pork carcases, 80; offal, 444 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa.—Corned beef, 18,420 lbs.; beef fat, 1,000 lbs.; beef paste, 15,000 lbs.; tongues, 360 lbs.; sausages, 1,204 lbs.; stew, 49,104 lbs.

To United Kingdom.—Meat extract, 13,487 lbs.; beef powder, 6,368 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-40.

Monthly Report No. 98. January, 1941.

Further egg-laying has taken place on a more or less extensive scale in five districts, namely, Charter, Bikita, Chilimanzi, Ndanga and Chibi. All these districts are in the eastern half of the Colony.

Hoppers commenced hatching early in the month in the Mtoko district and a number of bands have been destroyed, either by spraying or by beating with branches.

Rupert W. Jack,
Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date..194.....

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Salisbury.

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THE RHODESIA
Agricultural Journal

Vol. XXXVIII.] No. 4 [April, 1941

Editorial

Notes and Comments

Sub-Tropical Experiment Station.

About three miles from Umtali in the hills to the north-east is the Government Sub-Tropical Experiment Station which is becoming increasingly well known to visitors and residents. Here in a small area Mr. Rooke, under the direction of the Horticulturist, has planted out a bewildering variety of tropical and sub-tropical plants, most of which seem to be thriving. Perhaps the most outstanding demonstration is the rich bearing and high quality of pineapples which grow in soil varying from gravelly and stony to deep and loamy. Spacing and fertiliser trials are proceeding, but it is too early yet for any definite conclusions to be drawn.

Another example of luxuriant growth and high bearing is afforded by varieties of bananas near which are several varieties of imported guavas. There are three varieties of cinchona (quinine), 25 varieties of imported mangoes, and also cinnamon trees, all of which grow well. A considerable area is devoted to trials of coffee. The coffee bushes, the cinnamon and the bananas are irrigated from borehole water. The coffee seems to offer considerable promise, but as in the case of many of the other plants no definite conclusions can be made at this early date.

A crop which is new to most Rhodesians is the silvery leaved olive tree which is just beginning to bear at 2½ years old. Judged by size the fruit is stated by Mr. Marshall to be up to the usual standard. Near the olives is a row of canna-like arrowroot, which is grown from tubers.

Fairly extensive trials have been conducted in different types of berry, including the dewberry, the boysen berry, the Japanese gooseberry, the orange sunberry, the West Indies gooseberry and the youngberry. So far the youngberry is the most promising; this is a cross between a loganberry and a tropical blackberry. It grows fast and produces a good crop of large berries.

In addition there are deciduous fruits and exotic nuts too numerous to mention. Further details will be given of these when time has tested their possibilities.

Mr. G. W. Marshall, the Horticulturist, will be conducting farmers over the Station on 6th June. Any farmers interested will be welcome.

Food from the Air.

Nitrogen from the air, in addition to being the main source of explosives, enters extensively into fertilisers and into the manufacture of a group of compounds known as plastics. Now as the result of brilliant research work, chiefly at the Agricultural College of the University of Wisconsin, it is used to replace protein in cattle feeds. Urea is not a protein, it is a compound of ammonia and carbon dioxide, but in ruminant animals it is converted to protein. The rumen teems with billions of microscopic plants—mostly bacteria, some of which seize upon non-protein nitrogen and break it down to ammonia, which in turn is used by others to make protein. Animals, unlike plants, have themselves no mechanism for synthesising protein.

Up to three pounds of urea can be used to a hundred pounds of grain concentrate, with which it must be well mixed. Above that rate harmful results are likely.

In Great Britain where the importation of protein concentrates has been seriously restricted, the use of urea, if it can be spared from munitions, is likely to bring relief to the sorely tried farmers.

Tobacco.

A recent issue of the British trade journal *Tobacco* contains items of interest to tobacco growers. Under the heading

"Tobacco Names" three paragraphs are devoted to Mr. Lanigan O'Keeffe and his enthusiasm for Rhodesian tobacco. From the High Commissioner's office 25,000 cigarettes have been distributed free to Rhodesian troops in England, and a million and a half more will soon be given out. As the paper says: "The idea is that the men in uniform shall not smoke them all themselves—at least not the men with ' Rhodesia ' on their shoulders; handing round the cigarettes will speed the great work of propaganda."

In *Tobacco's* Empire Supplement is an article on Indian tobacco and a short note by Mr. O'Keeffe on Rhodesia's limitless possibilities. It may surprise many readers to know that India to-day produces one quarter of the world's supply of tobacco, although exports are comparatively small. Production in 1937-38 totalled 1,131,000,000 lbs., and the average yield per acre is 780 lbs.

In his note Mr. O'Keeffe says: "I believe that there is no reasonable limit to the possible expansion of tobacco lands in this young self-governing Colony of ours, and that the retailers and the smoking public could, unaided by other considerations, possibly double Rhodesia's British population, and spending-power in Britain, in ten years."

Rhodesian tobacco is well advertised throughout the paper.

Prisoners on Land.

The proposal aired in the local Press some time ago to bring Italian prisoners of war to work on Rhodesian farms finds an echo in England. But in England it is more than a proposal, it is a definite plan. Some of the dismay caused in agricultural circles by the announcement that farmers must expect to release a large number of men to the Forces, has been relieved by official announcements that Italian prisoners of war will be used in farm work in England. At the outset they will not work on individual farms; they will work in gangs on ditching, draining and so forth. It is understood that about three thousand will be introduced as a start. Italians are good farmers and their value to the British industry will be considerable. "It is confidently expected,"

says *The Farmer and Stock-Breeder*, "that the majority of Italians will be only too eager to work on British farms and get away from the Middle East."

Boron in Maize.

A series of articles on "Boron and Plant Life," by Dennis and Dennis, appearing in *The Fertiliser, Feeding Stuffs and Farm Supplies Journal*, reveals that boron plays its important role in cereals as in other plants, though less spectacularly. In the absence of boron in water and sand cultures, panicle formation was retarded, if not prevented, the ears were stunted and anthers were not formed. Occurrence of white stripes on leaves of boron-deficient maize plants was confirmed and shown to be due to the absence of chlorophyll and collapse of the cells in these portions of the lamina. The root weight was reduced more than the shoot weight as compared with normal controls. Plants deprived of boron proved on analysis to be strikingly deficient in proteins. An hitherto undescribed symptom was found in sweet corn and may occur in other maize. Golden Bantam sweet corn grown in sand without boron showed no external disease symptoms, but cobs when cut open showed a narrow corky brown band extending along the outer surface at the base of the kernels. This area was greenish-white and healthy in cobs from boron-fed plants.

Carrots.

Nowhere has the war caused a greater change than in the feeding habits of the British people and there is considerable talk in all the papers of common but overlooked foods. The vegetable which attracts the greatest attention after the potato is the carrot, which, according to an article in *Nature*, is known in East Anglia as the "King of Vegetables." It is universally liked, especially by children, and cooking by a variety of means presents no difficulty, the preliminary cleansing being confined to a thorough scrubbing. The roots contain 10-15 per cent. of solid matter, much of which is sugar, and the green tops which may be used instead of parsley are rich in Vitamin C.

The particular value of the carrot arises from its property of accumulating carotene, which in vertebrate animals, when

absorbed from the alimentary tract, is converted into Vitamin A. The highest concentration of carotene is found in mature plants: seedlings have practically none.

The place occupied by the carrot in the menu should be widespread but not unduly prominent. It is suggested that carrots should be dried and ground into a meal which might be valuable as a war-time constituent of cakes or biscuits.

The Weeping Willow.

An article by C. J. Uys in *Farming in South Africa* extolls the weeping willow tree (*Salix babylonica*) and urges its more extensive planting, quoting the Afrikaans saying, "Where the willows grow there will be prosperity." Cattle, horses, mules, donkeys, sheep, goats, pigs and poultry definitely relish the leaves and twigs of the willow, and it is stated that during the 1933 drought many starving cattle and sheep, too weak to rise, were fed on willow leaves, and were ultimately saved. Experiments carried out on poultry at the Potchefstroom College of Agriculture demonstrated the superiority of willow leaves over lucerne as a green feed for chickens. Analysis figures show that protein and phosphate are as high in willow leaves as in lucerne, and potassium and chlorine are considerably higher.

When full grown the weeping willow is a singularly graceful and ornamental tree, 25 to 30 feet in height. The branches spread far off the stem and droop in such a way that they give abundance of shade. Owing to the deep rooting system the leaves and twigs are absolutely fresh when, during the dry summer spells, grass and green crops are dry and wilted. A full grown tree will yield wagon loads of twigs and leaves for livestock, and the wood can be extensively used on the farm.

Willows prefer moist localities, as for example along river banks, spruits, water furrows, sandy hollows and dongas, and they are very easily propagated from twigs, branches or poles.

A glade of willows in a vlei would become a valuable sanctuary for weak animals, or for cows and heifers on the point of calving.

Roll of Honour.

DIVISION OF AGRICULTURE AND LANDS.

The *Journal* records with deep regret the deaths on active service of three young and promising members of the staff, and extends to their parents and relatives the Division's profound sympathy and respect.

Alan Ponsonby Burl.—Burl was born on 17th January, 1917, and was educated at Dale College, Kingwilliamstown, where he distinguished himself in the class-room and on the fields of sport. On 25th January, 1937, he was appointed to the Department of the Surveyor-General as Learner Topographer. He was called up for service as Airscraftsman in the R.A.F. on 25th August, 1939, was promoted Corporal on 20th October, 1939, and Sergeant on 1st June, 1940. On 27th November he was shot down near Metema by two enemy aircraft. His parents reside in Alice, Cape Province.

In the early afternoon of the 18th March, 1941, over Eritrea, four Italian machines shot down a plane of the Rhodesian Squadron and two young members of the Division lost their lives together.

Neville Sydenham Fairchild Tyas.—The son of Mrs. F. M. and the late A. Tyas, of Aspendale Farm, Salisbury, Tyas was born in Salisbury on March 22nd, 1917, and was educated at Prince Edward School from 1925 to 1934. After a school career distinguished not only academically but in the field of sport, he joined the staff of the Accountant's Office, Agriculture and Lands, on December 28th, 1934. Tyas was commissioned to 2nd Lieutenant of the Air Section of the Territorial Active Force on the 1st October, 1937. He was

promoted Flying Officer on the 13th May, 1939, and was called up for duty on the 25th August, 1939. He left the Colony a few days later and served with No. 237 (Rhodesia) Squadron from its inception. He was appointed Acting Flight Lieutenant on 1st February, 1940.

Rhodes William Horobin.—Horobin was born on the 29th August, 1921, at Benoni, Transvaal. He was educated at Milton School, Bulawayo, from which he matriculated in 1937. He was conspicuous in sport and was a Cadet Lieutenant in the School Corps. He joined the Department of Agriculture on 3rd January, 1938, and was called up for active service on October 25th, 1939. He left the Colony in March, 1940, and was promoted Sergeant (Air Gunner) on 1st August, 1940. His parents, Mr. and Mrs. D. W. Horobin, live at Shabani.

Letters to the Editor.

The Editor, *The Rhodesia Agricultural Journal.*

Sir,—During his recent trip to India Capt. Bertin collected various information about sunnhemp some of which is of considerable interest. Several kinds of hemp are grown, but it is our sunnhemp spelt in India sannhemp (*Crotalaria Juncea*) that is the most important. This plant is almost the sole Empire resource of soft fibre and is produced to a large extent only in India. It is extensively cultivated in the United Provinces, the area in 1938-39 being 2,006,804 acres. For fibre it is cut when the flowers appear. The leafy top is cut away for fodder. It will be seen therefore that making hay of this plant as has been done during the last few seasons in Rhodesia is quite an old habit in India. The stems of the plant after the tops have been removed are tied in bundles of 100 to 150 and submerged in pools of water. They usually take 3 to 4 days for decomposition, which facilitates the separation of fibre from the woody stalk. Shallow water of muddy pools gets warm in the sun and helps earlier decomposition, but running clean water gives brighter and better fibre. Proper retting is very important, or decomposition weakens the fibre and under retting takes off woody matter which reduces the value of the fibre. After retting the stems are washed. The lower portions are rubbed on the ground to separate fibres, this helps extraction. The bundles of the stems are beaten on the surface of the water and then twirled along. The bundles are then stacked in rows for the water to drain off and the fibre is then separated from the woody stalk. The separated fibre is hung on lines or laid on the ground to dry and then tied into hanks. These hanks are sold as such by the cultivators. The buyers beat the hanks with bamboos to pulverise the woody matter. Scutching is then done by drawing the fibre over nails which have been driven through a plank. At Chipoli last year the hanks were beaten and washed before being dried, perfectly good clean fibre was obtained in one operation and scutching was not found necessary. In India the hanks if meant for export are

then sent to baling machines when they are pressed and turned out in 400 lb. bales. The fibre is used locally for cordage, fishing nets, ropes, twine, patties, etc.

The Principal of the Government Textile Institute at Cawnpore stated that sunnhemp was extracted by retting. The fibre was then cleaned by hand, no machinery being used for the purpose. It was then converted into yarn and ropes by hand spinning. The opening and cleaning hand machines were portable and could be seen at the Institute.

As these machines are evidently simple and inexpensive could not our Government obtain one at once so that it can be tried out on the coming crop?

The wholesale cost of material such as these machines turn out, imported into Rhodesia last statistical year, was nearly £10,000.—I am, etc.,

J. M. MOUBRAY.

Chipoli, Shamva, March 3rd, 1941.

The Chairman, New Crops Committee, comments as follows:—

The whole question of the production of fibre from sunnhemp is being investigated by the New Crops Committee. An experimental sisal decorticating plant which was in use in Kenya has recently been purchased by the Government and has now arrived in Salisbury. A building to house this plant is under construction on the Salisbury Experiment Station and the experimental plant will be erected as soon as the building is completed, which will probably be within the next few weeks.

It is appreciated that in India the fibre from sunnhemp is obtained by retting the stems and then scutching them by hand; this, however, is a slow and laborious process and requires a great deal of labour.

If a suitable machine could be devised which would extract the fibre cheaply, the labour necessary to handle a large quantity of sunnhemp would be considerably reduced

and the costs of production of the fibre be greatly lessened. The residue from the sunnhemp after the fibre is extracted could be used for making compost and hence there would be no waste from the crop. The object of the New Crops Committee's investigations is to endeavour to devise such a machine, and an attempt will be made to modify the sisal decorticating machine so that it will process sunnhemp.

The machine is fitted with a combing device and it is hoped that it will be possible to utilise it both for the purpose of decorticating the fibre and then combing and grading it.

The Committee has no information regarding the hand spinning machine to which Captain Moubray refers, but will make the necessary enquiries. It is felt, however, that it is improbable that such a machine could be procured in time to try it out on this year's crop.

Nursery Rhymes for the Farm

SING A SONG.

Sing a song of cleanliness, or pests will multiply.
Four and twenty meal worms were baked in a pie;
When the pie was opened, the wife began to sing:—
Look at all the meal worms that I've cooked in this darned thing!
Expenditure on cleanliness is NIL upon this farm;
A little spent would surely do us very little harm.
Don't you know that cleanliness will keep these pests away?
Why sing a song of sixpence which is near a full day's pay?
Keep your *farm* clean, keep your *sheds* clean, *starve* the pests infernal;
Don't you know that So-and-so said so in the *Journal?*"

The farmer's in his office now, totting up his money.
His wife is in the garden gay, and she's as sweet as honey.
The boys are scattered o'er the farm, cleaning all in sight,
For they know now that this is how to keep the master bright.

Cleanliness Aids Insect Control.

Effect of Artificial Fertilizer on the Nutrition Value of the Plant.*

[Sir Albert Howard's well-known condemnation of artificial fertilisers has been mentioned before in this Journal, as has the commonsense view that fertility demands organic and artificial fertilisers together. The following note by Professor Scott Watson should be of interest to readers.—Editor of the *R.A.J.*]

From time to time the idea keeps cropping up that the use of chemical fertilisers is an "unnatural" expedient used by man to force his crops into "unnatural" growth (and thus tends to produce "unnatural" foods that may, in the long run, have harmful effects upon the animals or human beings that consume them. The suggestion is a difficult one to disprove, if only because it is usually made in a very vague and indefinite form. Thus it is useless to show that wheat grown with sulphate of ammonia and superphosphate has the same general composition as other wheat grown with dung or with the residues of the sheepfold; the difference may be one that does not show up in a chemical analysis. Again, it is useless to point out that an application of slag to a sheep pasture may lead to an obvious improvement in the health and growth rate of the sheep; that may well be true, but it may equally be true that there has been, at the same time, some obscure but nevertheless real deterioration in the food value of the mutton.

It is, of course, a well-known fact that the use of unbalanced manures, either natural or artificial, may have harmful effects on the nutritive value of a crop. Thus the excessive use of nitrate on a hay meadow may favour the coarse and innutritious grasses at the expense of the wild white clover and other desirable species; or the repeated use

*By J. A. Scott Watson, M.A., Sibthorpian Professor of Economy, Oxford, in the *Journal of the Ministry of Agriculture*, Vol. 42, No. 9, 1935.

of sulphate of ammonia may cause the depletion of the lime reserves of the soil and thus produce a lime-deficient herbage that fails to satisfy the calcium requirements of the animal. These, however, are merely examples of harm arising from the wrong use of artificials.

An interesting experiment that bears on the broad general question has recently been reported from the Veterinary Physiological Institute of the University of Leipzig. Two groups of rats were fed, for six successive generations, upon diets corresponding closely to an ordinary mixed human diet, the only difference being that for one group (Group V) all the constituents of the ration had been produced with the use of chemical fertilisers, while for the other group (Group U) the ingredients had all been produced without resort to artificials. For instance, the one group had beef from cattle fed on intensively manured pasture, while the other had the meat of cattle that had never consumed fodder grown with artificials. The diet was a good and very mixed one, including cereals (oats, barley and rye), vegetables (lettuce, spinach, cabbage, beans, peas, carrots, celery, tomatoes and potatoes), meat and milk. The conditions of the experiment seem to have been carefully controlled and the individual rats distributed at random between the two lots.

Most people would probably predict a negative or inconclusive result from such a test. Somewhat surprisingly, there were significant differences between the two groups, the differences being all in favour of Group V (artificials). The V-group rats of the parent generation seemed to be definitely more resistant to disease, and lived longer; of the first-generation progeny, Group V showed better general health, and the females continued to breed to greater ages; and taking all the generations the V group were more prolific and more vigorous.

These results should not, of course, be taken as suggesting that artificials are better than animal manures. The real explanation may possibly be that the farmer who uses artificials (in conjunction with dung, etc.) does, upon the whole, arrive at an improved balance of plant nutrients in the soil, and that this results in the production of a plant that, regarded as animal food, has an improved balance of minerals.

Erosion and Malaria.

MEASURES WHICH CONTROL BOTH EVILS.

By G. R. Ross, M.B., Ch.B., Ph.D., D.P.H., Director of the Public Health Laboratories,

and

D. Aylen, Technical Assistant for Soil Conservation.

Malaria is responsible for much of the sickness of this country, but exactly how much we don't quite know, as little attention is paid by the sufferers to the very numerous minor attacks which perhaps many dwellers outside the main towns contract once or twice a year. These cases are so common that the patient seldom receives professional medical attention and therefore no records of the incidence of slight attacks of malaria are available.

Unfortunately the layman is apt to overlook the fact that incipient malaria may manifest itself by no other symptoms than lassitude and inertia. An infection which causes only a slight illness may be kept in check or even apparently cured by self-treatment, but not always completely eliminated, with the result that the patient's vitality is gradually and imperceptibly lowered, decreasing his resistance to other diseases and perhaps laying the foundation for an attack of blackwater fever.

Just as insiduously as erosion saps the vitality of the land so can malaria sap the vitality of an individual.

The relationship between the disease of the soil and the disease of the body goes further than this simile. There is a definite connection between the two as, directly and indirectly, erosion provides a very large proportion of the breeding places of malarial mosquitos. In fact, it has been asserted on the basis of modern investigation and research that man's activities in digging holes and causing erosion are largely responsible for malaria.

Everybody knows that malaria is transmitted by the bite of the female of certain anopheline mosquitos and that mosquitoes pass through a larval stage in pools of water. Most of us know that breeding can be prevented or the larvae killed by either eliminating the pools, by draining or filling them with soil, or by regularly spraying them with oil each week. However, holes and pools caused by erosion are most satisfactorily treated by erosion control measures.

CONSTANCY OF THE BREEDING HABITS OF ANOPHELINE MOSQUITOS.

It should be realised that of the many anopheline mosquitos in Southern Rhodesia only two are regarded as carriers of malaria. These are *A. gambiae* and *A. funestus*. These, like all anophelines, are remarkably constant in their breeding habits. *A. gambiae*, probably the more dangerous of the two, breeds in small rainfilled depressions, without vegetation and exposed to full sunlight. The larvae are light in colour and very shy, rapidly diving to the bottom if the surface is disturbed, and even if a shadow falls on the pool or puddle, or they sense the vibration of approaching footsteps. With such habits, and breeding as they frequently do in depressions, only a few inches in diameter, their breeding places may be readily overlooked. Borrow pits, wheel ruts, erosion made pot-holes, animal hoof marks; in fact, any vegetation-free depression which holds water is a potential breeding ground.

Many such are unwittingly but intentionally man-made but many more result unintentionally from man's activities, and for every borrow pit there must be dozens of suitable breeding places created by erosion, that regrettable consequence of uncontrolled or misguided effort.

Anopheles funestus has different habits. The larvae live in partially shaded slowly moving water. A gully or a choked stream shaded by trees or rank vegetation may very often contain pools which fit this description. A gully in an advanced stage of erosion or a stream choked with erosional detritus (silt, gravel, etc.) thus contain breeding places well suited to this mosquito.

Fig. 1.—Pot-holes in the bed of a steep drain. Typical breeding place for *A. gambiae*.

Fig. 2.—Pot-holes in a disused footpath. Potential breeding place for *A. gambiae*.

Fig 3.—Pot-holes in a disused earth road. Potential breeding place for *A. gambiae*

Fig 4.—Silt derived from head erosion above a culvert forms a swamp below the culvert. Running water *A. funestus*. Footprints *A. gambiae*.

Fig 5.—A pool formed by the deposition of silt in a vlei. *A. funestus*

Fig 6.—A pool in a drain which has eroded down to hard material. *A. gambiae* shallow water at head of pool

EROSION PROVIDES BREEDING PLACES FOR MALARIAL MOSQUITOS.

The breeding places are almost entirely limited to places made by man, caused by man, or which have indirectly resulted from man's activities, in his operations of mining, tilling the soil, herding cattle, and making paths and roads and drains. It is the erosion resulting from these activities which is the greatest factor in providing suitable breeding places. In fact, to such an extent that eminent scientists now consider that it was malaria following serious erosion which finally brought about the decline of ancient Greece and Rome, and is now to a large extent responsible for the depression of the Southern States of the United States of America.

As we are mainly concerned with the elimination of breeding places within a radius of half a mile of human habitations this article will devote major attention to the types of erosion and ponding likely to be found within such areas.

Borrow pits made to obtain material for bricks, roads and "dagga" are obvious places which can readily be found and either drained, filled or oiled, but round every small town and village and every homestead and compound there is an area intersected by paths, roads and drains, both new and disused, where minor gully erosion generally is prevalent. (See Figs. 1 to 3.) There may also be small natural depressions as well as mud holes created by cattle and perhaps swamps or pools (Fig. 5) formed by the deposition of a bar of silt at the lower end of a drain or gully. Animals and humans walking across a freshly deposited bank of silt or a boggy place created at a gate or water supply will leave footprints which are quite adequate depressions for the larvae of *Anopheles gambiae* to live in. (Fig. 4.)

There is little danger in these pools if they are either dried up in a few days by the sun or flushed by heavy storms at weekly intervals, but the pool may be so situated that it is fed by a trickle and protected from a flush. Alternatively weather conditions may be such that for a week just sufficient rain falls to maintain the pool without flushing it. (Fig. 6.)

It is obvious that a weekly search for the purpose of oiling all such latterly described places would be tedious for a farmer or miner, and could not be safely entrusted to an ordinary native farm labourer.

Prevention and control of erosion is therefore far more satisfactory, and not only can it be effected by simple measures but a permanently satisfactory job can be done on a farm at a cost which involves little more than the use of a labour gang from time to time.

Gulley control, to the beginner, appears to be a task of frightening dimensions, but even big gullies can be controlled with a moderate expenditure if the flow of storm water can be reduced. Gullies only become difficult and expensive to control when they are deep and narrow and receive large volumes of water. It is seldom that this condition is found close to habitations. The task of controlling small gullies which have formed in paths, roads and drains is surprisingly cheap and easy.

Gully prevention seldom requires appreciable additional expenditure of labour or money, and as a rule is limited to planning a better lay-out of roads, drains and arable lands.

EROSION CONTROL, TIDINESS AND FAIR ROADS ENSURE GREATER FREEDOM FROM MALARIA.

Each homestead and farmyard, and each mine and compound or village commonage, will present different problems. An attempt is made in this article to cover all cases that are likely to be met, and to show how erosion can be overcome, the breeding of malarial mosquitoes greatly reduced, and the roads and general appearance of the area improved at one and the same time. Nothing creates a worse impression than an untidy precinct which is scored by eroding old roads and drains, and served by bad roads. Moreover, such neglect is neither healthy nor economical. The work suggested in this article is simple, the cost is surprisingly low and may even be negligible on farms if odd labour is utilised when work in the lands has been interrupted by rain. Even with apparently difficult cases, though at first the problems seem most involved they will soon vanish if a little

forethought is given to the planning of the order of the work. When once done not only will there be a general improvement both of looks and facilities, but future maintenance costs will be reduced. Besides these benefits the work may often be fully justified on the sole score of reduced sickness. Apart from the cost of medical treatment and loss of work through illness, persons apparently not ill but suffering from low fever are unable to put any vigour into their work or recreation.

A PLAN FOR FARMS.

This plan is based on the requirements of several farms which, owing to the larger than usual number of buildings, would require far more work than the average. Moreover, the list includes items which are only required on one or other of the farms, but it was thought as well, for the purposes of explanation, to draw up a list which includes all the work which would be required on a hypothetical farm which presented all the problems likely to be met.

Actually in the majority of cases much of the work will already have been undertaken for purely drainage purposes, and to facilitate the mowing of hay and bedding.

If this is the case little further work would be required to complete the drainage and to eliminate erosion and potential breeding places for anophelines. A small additional amount of work on drains would also reduce yearly maintenance of roads to an absolute minimum.

It should be realised that the costs given below take into account all the work that is required to control erosion, eliminate breeding places, and permit of mowing on the area including such work as has already been done which has achieved one or more of these objectives, whether intended or incidental. Most farmers will only require to complete a similar scheme and on a far lesser scale. In most cases the costs therefore will be far less than those given below.

1. *Storm Drains* above area (homestead, yard, buildings, compound, etc.). 500 yards x 8 ft. x 1 ft. on a gradient of 1 in 200.

2. *Grassed Channel.*—This item will be required to replace any eroding drain and might also be utilised for the reception of storm water from an additional area. 300 yards long and 25 ft. wide.

3. *Drains* round house, in garden and stock-yards and compound. 250 yards x 3 ft. x 6 in., and 1,600 yards x 8 ft. x 6 in., and 100 yards x 10 ft. x 9 in. Gradient 1 in 100.

4. *Road Drainage. Steep Section.*—8 herringbone drains each 33 yards x 3 ft. x 6 in. Gradient 1 in 100. 5 bolsters.

Gently Sloping Section.—Widen existing side drains to "grassed channel type," and use soil obtained to crown up road. Both sides of ¾ mile of road. Upper side of road 1,320 yards drain varying sizes from 2 ft. x 6 in. to 10 ft. x 9in. Lower side of road 1,320 x 3 ft. x 6 in.

Labour costs for these four items if done by shovels when the soil is damp and the surface has been broken by plough would be about £7, but if the soil is hard and unploughed labour costs will be much higher.

5. *Plant all bare areas*, and drains other than No. 1, with couch grass. Labour for this will cost about £2.

6. *Watering Troughs and Gates.*—The ground requires to be made up at 2 troughs and 3 paddock gates. Labour costs will be about £3.

7. *Gully Erosion.*—Some minor gullies will require a very limited amount of simple protection work. Cost of labour about £1. (Storm water which previously entered these gullies is now intercepted by the storm drains.)

It will be noted that the total cost of all these considerable improvements is £13. One item alone, *viz.*, better roads which require less maintenance, might justify this expenditure. A considerable amount of labour is unprofitably employed each year on many farms slashing grass, patching roads, making up boggy places, etc., and the days of labour lost owing to sickness is not inconsiderable. It should therefore be obvious that once completed a scheme like the one described will effect a considerable saving in labour. Cases

are not unknown where a farmer annually expends as much labour on patching a section of road as would be required to drain and make up that section.

MINOR GULLY EROSION—ITS NATURE.

Before describing in detail the remedial measures it would be as well to explain the process of typical minor gully erosion such as occurs in the vicinity of habitations.

The formation of numerous pot-holes is an outstanding feature of erosion in hard tramped places such as footpaths, lightly used earth roads, etc. (Fig. 3.) A hardened surface layer, even though bare, is itself fairly resistant to sheet erosion, but storm water will rapidly enlarge any weak spot such as a crack or rut, or even a hole left by decayed roots. The softer six inches or so of soil originally protected by the hard surface layer is then exposed and readily removed.

As little rain can penetrate these hard surfaces, showers which would all be absorbed elsewhere give a considerable run-off and erosion occurs during every storm, with the result that in spite of its apparently resistant surface an area that has become bare and hard, however small in extent, is sooner or later subjected to erosion which at first takes the form of pot-holes. Eventually pot-holes will each increase in length sufficiently to join up with ones above and below, and so will form a continuous but shallow gully. True gully erosion is then rapid, but owing to the nature of the early stages pot-holes in the bed will continue to be a feature, though by now they may have enlarged in size sufficiently to warrant their description as pits rather than pot-holes.

In any gully the slope of the bed is not constant, and erosion is most rapid wherever the gradient is steep or the formation soft. (Fig. 1.) The silt from these places is deposited on the flatter sections or where flow is restricted by an obstruction such as trash held up by roots, a projecting stone or a tuft of vegetation, and will form a shallow pool above each deposit of silt. (Figs. 5 and 6.)

The silt fans or deltas (Fig. 4) which are formed where-ever a gully or steep drain flattens grade or discharges can only be remedied after the source from which the silt is derived has been prevented from eroding.

PREVENTIVE AND CONTROL MEASURES.

Slipshod measures are doomed to failure. If the breeding places are to be eliminated a certain amount of thought must be given to the nature of each type of pot-hole, soggy place or gully, and the easiest and cheapest way of overcoming the problem chosen. While small borrow pits and natural depressions should be filled it will probably be cheapest to drain or oil large ones. It is obviously futile to fill holes caused by erosion with loose earth, or to dig through silt deposits, as the first heavy storm will undo all the work. Soggy places round gates and water supplies may or may not require a certain amount of erosion control as well as the obvious drainage, and raising of the surface with rubble or gravel. If stone slabs are available the immediate vicinity of troughs might well be paved.

Erosion control has a two-fold objective as regards assisting malarial control. Firstly, it prevents the formation of holes and secondly reduces the silt load of drains and channels to an insignificant quantity. Thus erosion control eliminates or assists the elimination of all potential breeding places which result from erosion.

One cannot do away with footpaths, cattle and wagon tracks, roads and road drains, but erosion in these can be prevented if the rain water is intercepted at close intervals by wide shallow drains on an easy grade. (Fig. 7.) Correctly graded drains will neither erode or hold shallow pools, and should be constructed across any area subject to erosion.

A drain with steep or almost vertical sides will sooner or later become partially choked by the earth which falls in as the sides crumble or slump. This earth will tend to create shallow pools in the drain or at its place of discharge.

For this reason the drains should be made wide and shallow with sloping sides and the earth should be thrown up well clear of the drain and formed into a smooth hump. Certainly not made as an abrupt bank right on the edge of the drain. If cattle are likely to walk over the drain the side slopes of both the cut and the bank should be more gentle than recommended in the Soil and Water Conservation Bulletin, Part II.

As far as possible all drains, banks and road verges should have such easy side slopes that it is possible to run the mower along them if not over them. Keeping the long kinds of grass and weeds short will improve appearance and discourage adult mosquitoes and also prevent annual weeds from gradually replacing the shorter grasses.

DESIGN AND LAY-OUT OF DRAINS.

Firstly, a storm-drain should be made above the area or areas in which are situated the homestead, stockyards, compound, etc. This drain might well be made according to the specification given in the above mentioned bulletin. However, it is necessary to make the drains within the area according to the dimensions which can be obtained from the following table, as the storm-drain sizes referred to are only applicable to catchments consisting of veld or protected arable lands, and a far greater volume of run-off must be expected from roads, roofs, and hard tramped or thinly vegetated areas.

DRAIN SIZES FOR BARE OR TRAMPED CATCHMENTS.

Gradient 1 *in* 100. *Side Slopes* 1 *in* 4 *or less.*

Acres	1	3	5	10	25
Bed width	3′	6′	10′	10′	15′
Depth of excavation	6″	6″	6″	9″	12″

It should be noted that the widths are *bed widths* and that side slopes are 1 in 4 or less. The spoil bank should be constructed some way below the lower edge of the drain and given similar or lesser side slopes. Short kinds of couch grass might well be planted on all spoil banks, and in the larger drains.

Normally these drains would be spaced at distances of from 50 to 100 feet apart according to the slope and degree of erosion, but consideration must be given to the position of buildings and roads so that the storm water is intercepted as near as possible to any point of concentration.

Provision must be made for the safe handling of the water discharged from the drains. Sometimes it cannot be led to a well grassed natural waterway or spread over a well grassed paddock, but must be taken straight down the slope. This can be done without fear of erosion if a grassed channel is prepared a sufficient time in advance for planted couch grass to entirely cover the surface. This type of drain is shallow and very wide, and may, in fact, consist of nothing more than wide low banks on either side of a strip of thick grass. The bed must be even, and level across at right angles to the flow, rising at the sides at a slope not steeper than 1 in 4 or 5.

For acreages up to 25 acres the bed width of these drain strips should equal one foot for each acre of catchment. This proportion may be slightly reduced for larger catchments, and a bed width of 45 feet is sufficient for 50 acres and one of 75 feet for 100 acres. These sizes are, of course, in excess of the sizes recommended for contour-ridge outlet drains, as in the latter case peak run-offs are only $\frac{1}{2}$ to $\frac{1}{4}$ the volume to be expected from the type of catchment we are considering.

The lines of the drains on gradient should be run out first as the position of the discharge drain cannot be chosen until the position of the drains on gradient has been marked out with a level, but they should not be dug until the couch grass planted in the downhill drains has formed a well-matted sward.

PLANT GRASS ON THE BARE AREAS.

The reclamation of the gullies and washes is best left until all the drains have been completed, but spare labour during this time might be utilised to fill borrow pits and to plant couch grass when silt can be checked by the simplest measures (Fig. 8) or on bare places which are not subjected to appreciable erosion. (Figs. 9 and 11.) All stages of the work, and particularly the grass planting, can well be carried out by a farmer when a sharp shower has prevented further work in the lands for the day.

The planting of grass on bare areas and places subjected to light sheet erosion only is best carried out by picking up narrow trenches a few inches deep on the contour at intervals

Fig. 7.—A well shaped and graded drain

Fig. 8.—A simple check holding up silt in a potential gully. Couch grass has been deeply planted in the silt.

Fig. 9.—Recently planted couch grass collecting silt on bare and eroding area

Fig. 10.—Couch grass strips across an eroding disused earth road. Note the stake checks in the shallow gully

Fig. 11.—Established couch grass strips on a previously bare area

Fig. 12.—Couch grass sod bolsters in a new road drain of good design. Slight erosion will soon be controlled.

of two yards. (Fig. 10.) Bits of couch grass are placed in the trench, the earth is then replaced and trodden down. Where the lines cross a small depression or minor wash it is advisable to bend them up slightly so that they will later have the tendency of working the water away from the centre of the hollow. (Fig. 11.)

The couch grass will soon form a living barrier which will collect any silt. (Fig. 9.) Later the grass will make runners, but it has been found that they are unable to take root on a hard bare surface. As soon as the couch grass has formed a living barrier, but not before, the area between the strips wherever the surface has been previously tramped very hard might well be loosened by breaking the surface with one blow from a pick every nine inches or so. A scraping action by a badza is exactly just what is *not* wanted. Drains in which erosion is slight are best treated by bolsters made of sods of couch grass held in place by pegs. (Fig. 12.)

The next stage is to knock in all gullies within the area protected by drains, intermingling couch grass roots with the last layer of the fill in the case of small ones, while the sites of larger gullies might well be planted with grass in strips shaped like a V with the point upstream and at one yard intervals.

It may be impractical to knock in the sides of large or deep gullies as soon as one would like. In this case shallow trenches should be dug across the bed at 3-yard intervals, half-filled with good soil and sods of couch grass put on top, as otherwise it is not likely the grass will be able to obtain a foothold in sterile sub-soil. Couch grass should also be planted in long lines either side of the gully some way back from the edge.

As opportunity permits the banks are then pushed in a little at a time. The grass in the bed will come up through this thin layer of covering and eventually the lines of grass at the sides make runners which go down the slope to join up and cover the whole gully.

The work of draining silt deltas formed at the lower end of drains and gullies can be commenced when the erosion

has been fully controlled round the habitations. Care should be taken that the work is done in such a way that the danger of starting new erosion is most unlikely.

The treatment of gullies where it is not practical to divert all storm water will be described later.

LAY-OUT OF ROADS AND THEIR DRAINAGE.

There are several different systems of road drainage which will satisfactorily overcome any danger of erosion.

In the first method the road is made just below a storm drain which has been set out on a non-scouring gradient.

Roads which are on a gradient at which ordinary storm drains would scour should be protected by very wide shallow drains planted with couch grass. When dealing with roads which must run almost straight up and down the hill and where there is veld or paddock on either side, the water in the side drains should be intercepted at intervals of 30 yards by herring-bone drains on a gradient of 1/100, of sufficient length and provided with wide outlets so as to spread the water far enough away to prevent its return to the proximity of the road.

However, in some cases it would be impossible to construct herring-bone drains as there is no paddock or veld alongside the road. In the case of new roads one should make very shallow grassed drains on either side of the road and use the soil dug out to crown up the road. Bands of couch grass should be planted at close intervals across the drains before erosion can commence. In fact, it would be as well to make this kind of drain at the end of the rainy season in order to give the grass every chance of becoming established before it is called on to withstand a strong flow of water.

If a side drain has already commenced to erode it must either be treated as a gully or alternatively a grassed drain or grass strip might be prepared just outside of the gully, and as soon as the new drain or strip has become established with grass the gully can be knocked in and small dams made across it so as to intercept the water at frequent intervals and discharge it by short drains into the grassed drain or strip.

HINTS ON FARM ROAD CONSTRUCTION.

Roads and tracks are abandoned and new ones made because the old ones have become pot-holed or gullied. This process goes on in some farms and commonages until perhaps six or seven tracks have been worn out and left to become gullies.

Even an unsurfaced earth road will last for a very long time if it is well crowned and the drains constructed so that the rain water can at once run away from the edges of the road. A recent article in the *Rhodesia Herald* described a very suitable method of road construction and drainage of a type jointly recommended by the Kenya Soil Conservation Service and Public Works Department.

If a road is crowned and well drained only the surface will become wetted during a storm and will soon dry afterwards, whilst the road material underneath will remain hard and dry and thus with little delay it may be used without danger of being cut up. If possible, one should avoid using earth roads during and immediately after rain, as once rutted pools are formed which lead to the water-logging of the foundation.

It is impossible to prevent slight depressions being worn in the wheel tracks and rain water will tend to run down these and erode them on any road which has a fall. The only remedy for this is bolsters, but there is no need to make the kind of bolster that will break springs if crossed at more than 15 miles per hour. Bolsters every 30 yards need not be more than a few inches high, and if given easy side slopes of 4 or 5 to 1 will prove very minor obstructions.

Footpaths cannot be eliminated and restriction on their number and direction is difficult, but it will be found that natives will tend to use the roads and the spoil banks of drains which will help in reducing the number. Small bolsters of couch grass sods will prove to be the most satisfactory method of overcoming the early stages of erosion in footpaths.

Whenever possible the roads should be realigned so as to follow immediately below a drain which has been set out on a non-scouring gradient. Where this is not possible and

the area has been extensively drained it will be found easier to cross the drains abruptly rather than at an acute angle. The drains then either cross the road as shallow inverts, or if flowing away from the road a bolster can be made just above each side drain instead of an invert.

TREATMENT OF SMALL STREAMS.

It is possible that within half-mile of the habitations there are streams which can provide breeding places for *Anopheles funestus*. Some of these places may have been created in the stream bed by deposits of silt and gravel derived from erosion in the area above. In that case the erosion control work above will have somewhat relieved the situation and silt bars and spits may now be removed. The object of *A. funestus* control should be to get a steady smooth flow in the channel with no slack water caused by eddies or obstructions, and to cut down any tall weeds and grass so that any potential breeding places are exposed to full sunlight. Remember our two dangerous anophelines have very dissimilar breeding habits.

If the stream is eroding, treatment as for gully erosion should be applied.

FURTHER NOTES ON THE CONTROL OF GULLY EROSION.

A number of methods for the prevention and control of gully erosion are described in the Soil and Water Conservation Bulletin, Part IV., but it might be as well to re-describe here some simple and cheap methods as well as additional ones, but devoting more attention to gullies of a type likely to contain potential breeding places.

The treatment of small gullies from which it is possible to divert all the water has already been described. Treatment described here will be limited to that suitable for gullies which receive a small flow of water during storms. Large gullies which must carry great volumes of water can only be satisfactorily treated with masonry or concrete structures —a subject which falls outside of the scope of this article.

The ultimate object of all gully control is the establishment of a thick cover of erosion resistant vegetation on the site of the gully, and methods should be aimed at accomplishing this object at the lowest possible cost.

Earlier in this article a reminder was given that prevention is cheaper than cure. All gullies start from small washes which can be healed by vegetation if simple and cheap devices like those illustrated in Figs. 15 and 16 are made in wash before it becomes a gully.

Comparison of these two photographs with Figs. 17 and 18 needs no further written explanation to drive home this point.

Naturally it cannot be expected that any vegetation planted in any gully large or small will grow unless favourable conditions are created.

It should be obvious that plants are unable to establish themselves when the soil is either (*a*) unstable or crumbling, (*b*) very hard or consolidated, (*c*) too dry or too wet for the particular species planted, (*d*) lacking in fertility.

Many attempts at gully control have failed miserably because it has been overlooked that plants cannot grow on steep crumbling banks however fertile, or in loose silt in the bed of a gully if that silt is disturbed by every flow. Neither can they grow in sterile soil, hard packed gravel or clay. Only certain plants can grow in water and only certain others on extremely dry banks, but fortunately some of our commonest grasses and plants can grow in water whilst others grow in dry places. The hardiest of these should be chosen, not forgetting that they must be able to make an erosion resistant cover, and be able to do this rapidly.

With this description in mind anybody ought to be able to find some suitable species near at hand, if not already growing in the gully itself. It is a mistake to take grass, plants or tree or shrub cuttings from close at hand but growing under completely different conditions of soil and moisture. Instead one should obtain the material from places where the conditions are as nearly as possible equivalent to those of the place to be planted.

The first object will be to stabilise the soil in the floor of the gully with checks at sufficiently close intervals to permit of the establishment of living barriers, and to smooth down the sides at the same time or later to a stable slope (*i.e.*, the lesser angle of repose of the particular soil when either dry and loose or saturated) (Fig. 17) in order that there will be no further crumbling of the bank.

The size and nature of the checks will depend on the size of the gully, the flow of water and the material available.

In the smallest gullies such as are formed from paths the checks need consist of no more than sods of couch grass in shallow holes about every five yards. It might pay, however, to instal a few small checks to catch silt. (Fig. 8.)

With gullies a little larger it would be as well to hammer in a few pegs on the lower side of the sods in a line across the bed (Fig. 14) and to continue the line part way up the bank. The hole in which the sods are to be planted would take the form of a shallow trench and also be taken some way up the sides.

If the gully is about three feet wide very low wide "bolsters" of couch grass sods might be used. (Fig. 12.) The sods should also be prevented from being washed out before becoming established by a peg fence on the lower side. In all cases the pegs should be hammered in until their heads barely project above the level of the other material used to make the check.

If there is any appreciable flow of water and suitable stones are available a few should be buried level with the surface just below the check. Alternatively the distance between checks should be reduced.

Gullies with a bed width of over 3 feet require a little more extensive treatment, depending in degree on the maximum depth of flow to be expected. This might take the form of numerous low pole-and-brushwood check-dams. (Fig. 13.)

Numerous small checks at 5 to 10 yards intervals serve the purpose far better than large checks at greater intervals.

The simplest brushwood check is constructed as follows. The bed of the gully is dug out level at the chosen site for a width of about two yards, and the banks on either side cut out at a gentle slope for an equal width. If the soil is infertile a shallow trench about 2 feet wide is then made along the upper side of the strip and refilled with fertile soil.

A line of stout stakes is now hammered in at the middle of the levelled strip and up the sides of the gully. Spacing between stakes will depend on how far they can be hammered in and on the expected flow of water. The tops of the stakes are levelled off so that they all project an even distance of about one foot.

A layer of brushwood or tough fibrous stalks is now placed to form a mat below the stake fence with the butts pointing upstream and projecting a few inches through the fence. A line of similar material in the form of a long bundle is placed on the butts and pressed down and secured by tying poles placed on top to the pegs.

Some straw or grass should be packed against the bundle of brushwood. The hollow above the check dam is then filled up to the level of the cross poles with good soil. Roots of suitable grass may be intermingled with the soil.

In the case of large gullies tree or shrub cuttings, seedlings or suckers are planted in rows just above each check-dam as soon as the soil has firmed down.

These cuttings may be native reeds and bamboo, poplar and willow, mulberry, Mauritius thorn, cactus, aloe, sisal, agave, etc., according to whether the gully is wet or dry. Many indigenous bushes and trees which will grow from truncheons might also be used.

As soon as the barriers of tree cuttings or lines of grass roots have become established they will cause silt to be deposited above them; it is well worth while to plant further vegetation in these silt deposits, following it up at intervals until the gaps between checks are entirely planted.

TREATMENT OF BANKS OF LARGE GULLIES.

Some difficulty and even failure will be experienced in the attempt to establish vegetation on sloped off gully banks

unless certain precautions are taken. (Fig. 18.) Remember that if a steep surface is bare the rain water will be shed rapidly, sheet erosion will be severe, and the soil may be lacking in nitrogen and humus.

If the soil is moderately fertile and absorbent contour lines of couch grass at yard intervals will probably be sufficient to ensure a satisfactory covering but in most cases in order to avoid failure it is necessary to broadcast seeds of vigorous annuals such as sunnhemp, amber cane, Sudan grass, munga, niger oil, manna, etc. These plants will not make a very extensive growth and may not set any seed, but they will, to some extent, prevent erosion, provide some humus and form a protective mulch, which will greatly assist the establishment of the permanent vegetation.

These plants may, however, fail to grow or may be washed out when small unless a very light covering of straw or coarse hay is spread evenly over the area immediately after broadcasting the seed. This straw mulch should be just thick enough so that the soil is half visible through it. It has the effect of reducing erosion and evaporation, it provides a little shade and it increases the penetration of rain water. It also prevents the surface from becoming hard and packed, and later supplies humus to the soil.

If the couch grass is planted just before doing this work a little wider spacings between the rows and in the rows may be used. The grass will not make much growth the first season, but will get away rapidly the following one and will cover the area before the stalks and roots of the annuals have rotted.

The work that should be done round homesteads, yards and compounds, and described earlier in this article, has been designed so that it can withstand a small amount of accidental trampling by stock, but it would be as well to avoid this eventuality until such time as the grass has made a good cover and even then stock should be kept off as much as possible. Note the damage done by stock in Fig. 13.

The true gully control measures described above will only be successful if both stock and fires are entirely kept out. A wire fence and a fireguard should, if possible, be

Fig. 13.—A gully recently treated with checks and plantings of couch grass Note damage by stock.

Fig 14.—Small checks of stakes bush and stones in an eroded road. Three weeks old planting of grass is already making runners

Figs. 15 and 16.—Small checks of various materials. Planted couch grass will soon effectively cover these gullies

Fig. 17.—Sloping down the bank of a large gully.

Fig. 18.—Planting grass and shrubs in a large gully after building checks and sloping down the sides. Storm water will be diverted until plantings are well established

put round every large gully, but if this is thought to be too costly a stock proof hedge should be planted of one of the following: Prickly pear, Agave, MacCartney Rose, Kei apple, Mauritius thorn, Hawthorn (Golden berry), Acacia detinens, Bougainvillea, or other shrubs which would serve the purpose.

TREES.

Though usually only planted to provide shade or improve appearances trees may be utilised to dry up moist patches of soil.

The limiting factor in preventing growth on areas which become soggy during summer will be the lack of aeration of the soil due to water-logging. Usually it will be found that such places have shallow top soil overlying clay. This factor may be overcome to a large extent by planting the trees on low wide mounds of soil. These mounds are most conveniently made out of the soil excavated from the drains, and should be made just below the drain. In the case of a large drain the spoil bank might well be widened out to a long, very low mound.

Besides the commonly planted Jacaranda, Cedrela toona, Syringa and Bauhinia, which should be confined to well drained situations, there are quite a number of hardy trees which will serve the purpose. The following list gives some suggestions from which a choice can be made. The most familiar name, whether "common," Latin or native, has been given in each case:—

Best raised from Seed. Indigenous.—Rhus lancea (Karee boom), Dodonea viscosa, Muchemberi (or Muchecheni).

Exotic.—Eucalyptus rostrata (Red gum), Eucalyptus tereticornis, Cupressus torulosa (Himalayan cypress), Pinus longifolia (Himalayan or long-leafed pine), Privet.

Best planted as truncheons.—The wild figs, Kaffirboom, Mukwa (Mubvamaropa), Mushamba and several other indigenous trees well known to natives.

Can be planted as cuttings.—Mulberry, Poplars, Willows.

Other hardy species which have proved themselves in the locality would no doubt also prove satisfactory for this purpose provided the trees are given sufficient attention.

The Farm Home

Bottling of Fruit.

Until the year 1810 the only preserving of food was done by salting, drying and in vinegar. In 1795 the French Government offered a prize of 12,000 francs for the best method of preserving. The necessity for this generous offer was brought about by the fact that an army marching through an enemy territory had to be fed and therefore large quantities of food had to be transported. In 1804 Appert discovered the secret of hermetically sealing containers, and by 1810 had experimented sufficiently to win the prize offered. The method he used was very crude and there was no knowledge of the presence of bacteria. Some years later Pasteur decided that decay was due to organisms in the food itself.

Preservation of food in air tight containers has developed greatly in recent years and the housewife can make use of surplus fruit and keep it for a time of scarcity very easily. Canning in its true sense can be done very easily in the home provided one has a small hand canner for sealing the tins. There are two main methods used in the home:—

(*a*) Bottling, sometimes called hot pack method.

(*b*) Sterilising or cold pack method.

The first depends on the ability of the housewife to sterilise the fruit by cooking and sealing the jar before any further organism can enter. The second method is by far the safer and more successful and is described in this article.

The following are important steps in bottling fruit whichever method is used.

FRUIT.

A. *Picking.*

(1) Fruit should be slightly under ripe. If too ripe heating breaks it up; if too green there is no flavour.

(2) If soft fruit pick into something shallow.

(3) Preserve as soon as possible after picking.

(4) Do not pick immediately after rain or heavy dew.

B. *After Picking.*

(1) If kept overnight great care is necessary.

(2) Spread fruit out as much as possible as mould will form if piled up at all.

(3) Keep in a cool place.

(4) Soft fruits may require washing, but *avoid* as it softens and causes loss of flavour.

(5) Bloom should be wiped off before putting in bottle.

(6) Grade size of fruit roughly.

(7) All blemished fruit should be discarded.

BOTTLES.

Types.—A. Screw band type.

B. Clip or vacuum bottle.

(1) Narrow neck.

(2) Glass top.

(3) Straight sides.

(4) Metal top (danger of metal in contact with fruit).

Choice of Bottle.

(1) There must be no chip on either edge of lid or bottle.

(2) Seam at top of bottle should be smooth.

(3) Test lids on bottles as they may get mixed in washing.

(4) Test screw band on lid, particularly if using old bottles.

(5) Note rubber ring; test for cracks by stretching.

(6) Soak new rings in warm water.

STERILISING METHOD.

Packing Fruit.

(1) Pack as tightly as possible without bruising or bursting.

(2) Pack so that finished product looks attractive.

(3) Knock down lightly and shake to remove air.

(4) When soft fruit is packed solidly it is difficult to fill with syrup, so it is advisable to put a little syrup in when some fruit is in position.

(5) Syrup will vary in strength according to fruit, usually 8-12 gs. sugar to 1 pint water. Boil, skim and strain before using.

(6) Syrup should be cold or warm, but never hot.

(7) Put ring on before adding syrup.

(8) Fill till syrup just overflows (therefore stand in basin to fill).

(9) Pour in slowly to avoid air bubbles and give bottle a jerk round to remove any bubbles.

(10) Put on lid and test with fingers to see if ring is flat, etc.

(11) Screw down metal tops tight and then make a half turn back or put clip in position.

(12) Put bottles into large saucepan or special container with pad of paper or wood underneath. Bottles must never touch bottom or sides of pan nor touch each other. Pad sides with old newspaper or straw.

(13) Fill pan with cold water until bottles are completely covered. (Water should be same temperature as syrup.)

(14) Put on lid and heat to required temperature.

TIMES.

If water is allowed to boil a shorter time is required, but colour and flavour of fruit is not as satisfactory. The following times give a rough idea, but it must be remembered that fruit varies from season to season and also some fruits take longer to cook than others.

NOT USING BOILING POINT.

A thermometer is necessary.

Average for all acid fruits.

Bring water up to 165°-170° in 1½ hours.

Fruit lacking in acid.

Bring water up to 190° in 1½ hours.

The water must be brought to the required temperature very slowly.

Up to 100° in first half hour.

Up to 130° in one hour.

Up to 160° in one and half hours.

Note.—The maximum temperature should be retained 10-20 minutes.

USING BOILING POINT.

When water is brought to boiling point the following times are average.

Apples.—36 minutes from when water boils.

Apricots, Peaches and Plums.—29 minutes from when water boils.

Pears and Guavas.—36 minutes from when water boils.

Pineapple.—54 minutes from when water boils.

Hard fruits like quinces should be cooked first and then timed as peaches.

These times alter at different altitudes owing to the change in boiling point of water. The times given are those suitable for Salisbury.

TO FINISH OFF BOTTLES.

(1) When maximum time is reached remove from stove and leave in water for a short time.

(2) Remove bottles on to wood or paper out of any draught.

(3) If screw top screw down tightly.

(4) Leave undisturbed till quite cold.

(5) Test every bottle to see if sealed. Vacuum top bottles, lift by lid and if sealed the lid will remain tight.

There is no satisfactory test for screw top, and only appearance of fruit in a day or two will guiae.

(6) Remove clips and do not replace owing to their stretching and thus causing a spoiling of the sealing power next time used.

STORAGE.

Store in a place which is—

(*a*) Dry. Dampness destroys the rubber ring.

(*b*) Cool.

(*c*) Dark. Colour deteriorates otherwise.

Note.—Some fruits shrink a great deal when sterilised; in this case it is advisable to blanch. The fruit should be dipped into enough boiling water to cover for a specified time (1-2 minutes), then plunged into cold water for a few seconds.

Blanching serves—

(1) To kill organisms on the outside;

(2) to shrink the product and thus more may be packed into bottle;

(3) to start flow of colouring matter;

(4) to get rid of certain objectionable acids.

Success in bottling depends on—

(1) The condition of the fruit; spoilt fruit cannot be bottled;

(2) the perfect jar;

(3) good new rubber rings;

(4) thorough sterilisation;

(5) perfect sealing.

Housing and Feeding Adult Poultry Stock

By H. G. WHEELDON, Poultry Officer.

PART I.

(Figs. 1 and 4 are held over and will appear in Part II.)

Poultry farms, whether large or small, must be managed on a businesslike basis to be profitable.

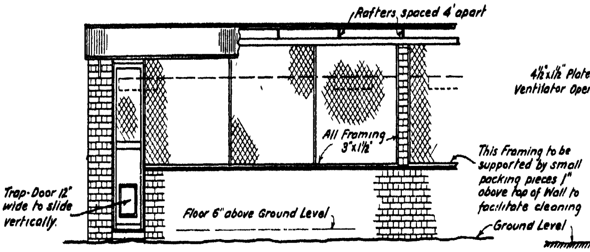
In laying out any poultry farm it is advisable to plan for gradual development from a small beginning to any desired size. It is inadvisable to commence poultry farming on too large a scale or to contemplate the immediate completion of a poultry farm on a scale beyond the experience of the farmer, and one that may require more than the capital available. A small plant suitably situated and managed on businesslike lines may be systematically planned and developed into a large poultry enterprise and gradually established on a profitable basis more easily and more economically than is likely from an effort on a large scale without previous experience. A successful poultry farm should furnish profits in proportion to its size and the practical experience and capabilities of the would-be poultry farmer during its development. The beginner will find that it is more economical to overcome possible reverses through inexperience during the initial stages with a few rather than a large number of birds.

Of all matters associated with the establishment of a poultry farm the selection of a site and construction of a suitable plant are the first to be considered. The site and accommodation are generally regarded as being of considerable importance for the maintenance of health and production. Poultry houses, apart from the protection and comfort they afford, are essential for the proper control of the flock as a whole. The climatic conditions require consideration, as this to some extent governs the design of poultry house to adopt.

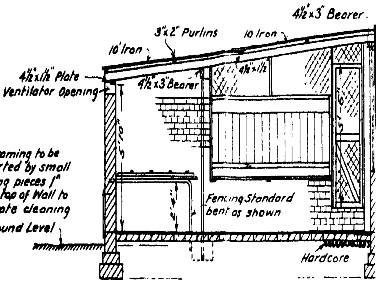
The climate in Rhodesia, however, is such that reasonable protection from rain and heat rather than from intense cold should be the main object. In this Colony the design of poultry houses can be simplified and they are fortunately economical to construct. In order to derive the maximum results suitable housing accommodation is as essential as the possession of good quality stock and supplying properly balanced rations. It is not necessary to provide elaborate housing, but it is desirable as it is important, that the accommodation should be durable, neat and easily accessible from the point of view of construction and layout of the plant. It is necessary to embody the principles required for the maintenance of good health and the comfort and protection of the stock—protection from adverse weather conditions and their comfort and health are ensured by suitable ventilation, cleanliness and freedom from insect vermin. Ample fresh air is necessary at all times and reasonable protection from rain and draughts when roosting at night. The number of birds accommodated in any one unit should not exceed the capacity for which the houses are planned and thus avoid any tendency to overcrowding the stock.

The stock require reasonable exercise to keep healthy and productive, and when confined in the intensive or semi-intensive systems they must be provided with the opportunity to move about freely, and the food hoppers and nest boxes must be easily accessible to all of them without molesting one another unduly, as is often the case with overcrowded flocks. The houses most suitable for the intensive or semi-intensive systems are those designed to combine roosting and exercising accommodation. The houses must be larger when confining the birds all or part of the time than if they have access to free range, in which case sleeping accommodation only is required. The stock under proper environment, usually remain active, tame and thrifty, all of which are conducive to satisfactory egg production. This applies to all systems of housing.

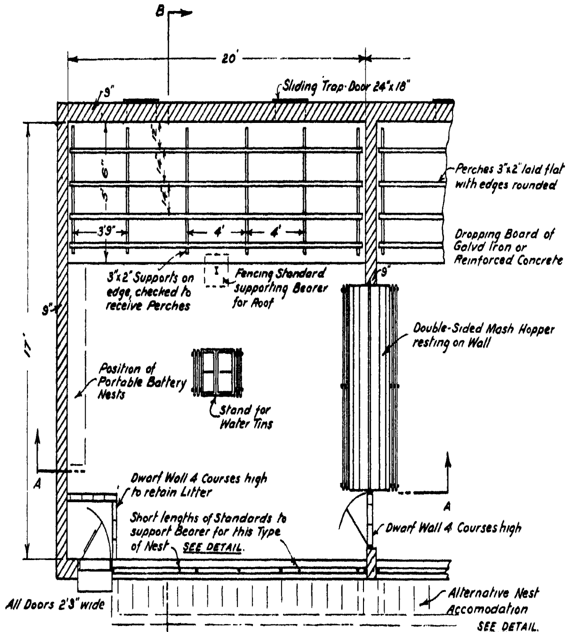
Successful poultry farming is determined by those engaged in the industry maintaining their stock in a healthy vigorous condition and the productivity of the flock by minimising the prevalence of disease and mortality. The



FRONT ELEVATION.

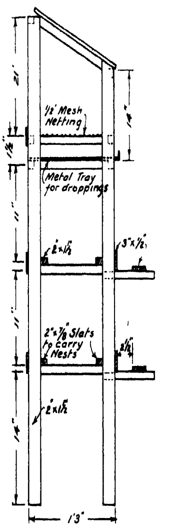


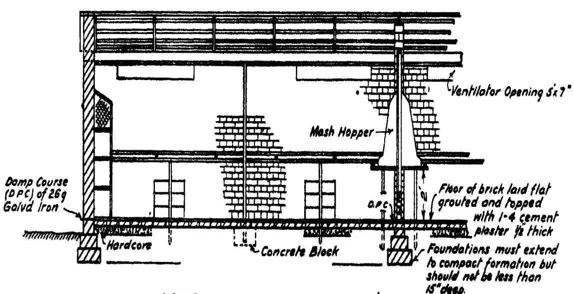
CROSS SECTION B/B



PLAN.

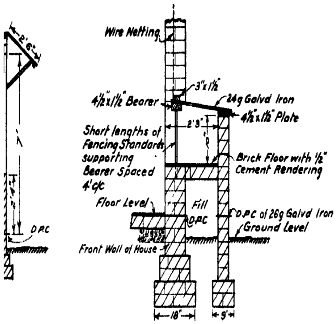
(This House will accomodate 100 Birds)





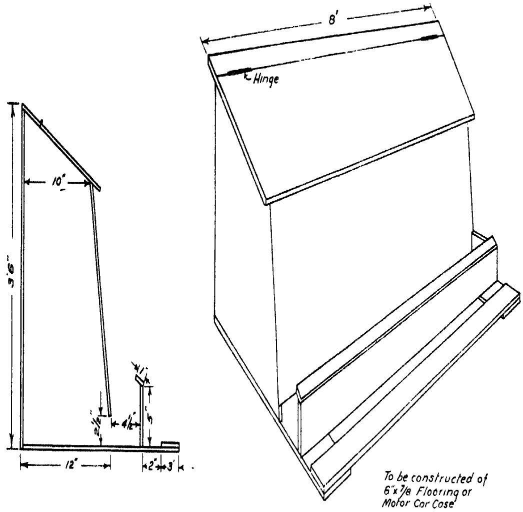
LONGITUDINAL SECTION A/A.

SEMI INTENS

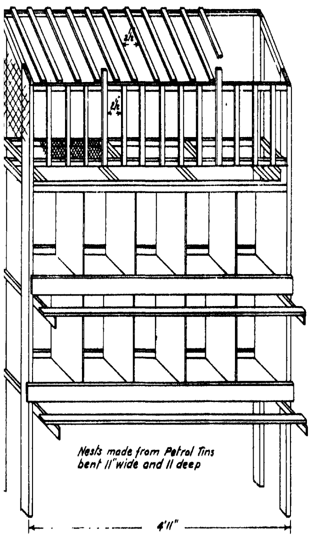


Permanent Nest Accomodation which may be built in front of the House as indicated on Plan as an alternative to the Portable Battery Nest which is recommended

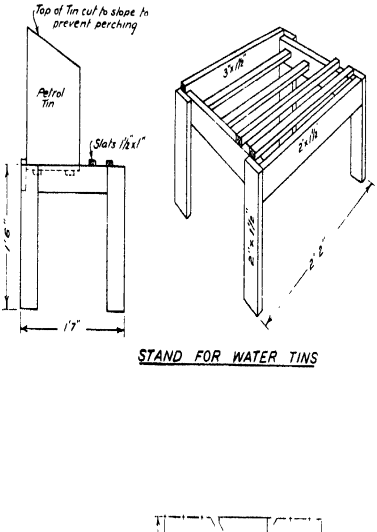
The House shown on this Drawing will require a Battery of 16 Nests



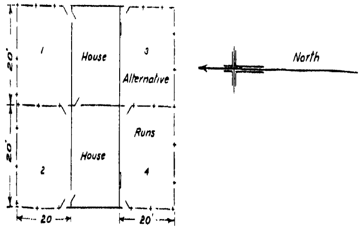
MASH HOPPER



PORTABLE BATTERY NESTS



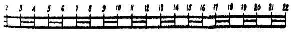
STAND FOR WATER TINS



LAY-OUT OF HOUSE & RUNS.

IRRIGATION DEPT
SALISBURY FEB 1941
A.G.B

IVE HOUSE & APPLIANCES.



Scale of Feet.

(For House Only.)

Fig. 3.

well-being of the stock is dependent not on the contents of a bottle so much as upon sanitation, proper nourishment and good management.

There is probably no matter of greater importance to the successful poultry farmer than that of feeding; for this a knowledge of the use of the various foodstuffs, method of feeding and proper management of the flock is necessary.

The feeding of adult stock, for commercial egg production and breeding purposes, is to some extent different to that for growing stock. The main object in feeding adult stock is primarily the production of eggs, and in order to fulfil this object their stamina and condition must be maintained. In the case of young growing stock the rations supplied must ensure constant growth and development from hatching to laying maturity and raising vigorous birds sound in constitution that would be capable of the production of standard sized eggs. It is desired that the young stock should mature normally on time with robust development. The rations supplied to both adult and growing stock must be satisfactory in quality and sufficient in quantity to secure the objects in view. Poultry farmers should have a thorough knowledge of the principles underlying the feeding of stock, and good management of the flock demands constant observation. The adult stock may be overfed on occasions when the ration may well be reduced or regulated to meet their requirements, and the young growing stock often underfed when generally their requirements are a full ration throughout the growing period. Although it may be possible for many poultry farmers to obtain mixed foods suitable for egg production or the rearing of young stock, it is not always possible for some commercial poultry farmers to avail themselves of such opportunities. The distance from towns adds considerably to the cost; and it may be possible to make use of suitable foods available in different localities at more economical values.

On the other hand, the principles of housing apply to both growing and adult stock, *viz.*, ample ventilation without draughts or overcrowding, water-tight roofs, impervious dry floors, and the houses should be so situated as to admit sunlight during the day.

The Site.—In selecting a site for a poultry farm the important considerations to bear in mind are: health of the stock, prospects for extension, convenience to the attendant, distance from markets and marketing facilities.

The well-being of the stock is determined to some extent by the suitability of the site such as the soil, drainage, contour of the land, natural protection or exposure, shade and range. In general a dry porous soil, naturally well drained, and land with a gradual slope towards the north which may be reasonably well sheltered by trees or hills from the prevailing strong winds, opportunities for free ranging, extension of the plant and water facilities are the main features to observe for an ideal site.

Land with a porous subsoil is less liable to become tainted if reasonably well elevated, alternately a site with heavy subsoil and low lying ground soon becomes fouled during the rainy season. The latter minimises the possibility of success and entails an enormous amount of labour and expense to keep clean and free from disease.

The most satisfactory aspect is a northern one; the contour of the land falling gradually in a northerly, north-easterly and north-westerly direction generally affords the greatest protection together with surface drainage. Poultry farmers should turn to good advantage all the natural protection available, such as trees or hills on the windward or southern side of the plant. Access to the shade of trees in the runs and range is desirable; any indigenous trees should be protected for this purpose, thinning out the scrubby bushes only where necessary. In the absence of other trees the planting of ornamental or fruit trees to become established without delay is recommended.

The possibilities for free ranging the growing stock and extension of the plant deserve consideration in the initial stages and should not be lost sight of in planning for future requirements. A good water supply in proximity to the plant is undoubtedly one of the most important factors, and where surface water is not available the possibilities of an underground supply should not be overlooked.

The site should be easily accessible to save time and economise in labour. The layout of the houses and runs should be systematically and conveniently arranged, not spread out indiscriminately. Convenience of access is important from a labour saving point of view and facilitates observation of the stock and plant. The poultry plant might be conveniently established in proximity to other farm buildings; it is also safer as it often tends to lessen the risk of marauders. In some localities hawks and other poultry pests are troublesome, including thefts, and one must plan to meet such emergencies.

The marketing of poultry products entails the handling of perishable products, and fortunately in this Colony road or rail transport facilities are available at regular and frequent intervals in the majority of districts.

The General Construction of Poultry Houses and Runs.—The work connected with poultry farming is not necessarily burdensome, although constant supervision is required. The mere fact that many details require daily attention makes it necessary to provide convenient houses, internal fittings and gates, and in no other undertaking is this better illustrated than in the poultry business. Whenever the work can be done conveniently it is less liable to be neglected.

The internal fittings should be systematically arranged and detachable, that is, food utensils, nest boxes and the perches. The gates should be easily accessible, properly attached to swing clear of the ground and equipped with secure and convenient fasteners.

The housing accommodation determines the carrying capacity of the farm, but in addition to this enclosures or runs of wire netting may be provided. It is not necessary to construct elaborate houses, but they should be well built, neat and large enough to accommodate the required number of birds, and preferably with smooth walls having no cracks or crevices in the interior. The houses should be open in front, but covered with wire netting.

The most economical and preferable type of permanent building is the combined sleeping and scratching shed. By combining these under one roof and with a dropping board 2 feet 4 inches, and the utensils elevated at a convenient

height, it is possible to provide the maximum indoor exercising and sleeping accommodation. When a separate scratching shed is arranged it naturally follows that the houses need not be large; sleeping accommodation only would be necessary, as it would be of little service during the day. A detached apartment for scratching is often a temporary structure provided to minimise initial capital outlay but usually requires periodical renovations. The provision for scratching outside without overhead cover proves unsatisfactory, especially during the rains and in hot weather.

The general principle should be to provide a sufficiently deep house having a dropping board along the back wall upon which the required number of perches can be arranged. The food utensils and nest boxes should be placed at a convenient height from the floor to facilitate sanitation and use of the whole of the floor area for exercising accommodation. This principle applies to all permanently built large or small houses intended for adult stock. Dropping boards could be dispensed with by substituting the floor immediately below the perches, keeping this free from grass or litter by a partition dwarf wall 12 inches high in front of the perches in a line parallel with the back wall. The remaining portion towards the front of the house is then available for exercising. By this system of arrangement a smaller area is provided for exercising and must necessarily reduce the carrying capacity of the house, especially in the wet weather. The advantages of a dropping board even with its additional cost easily outweigh the dis advantages of not providing one. Another important objection to this system is that the stock is more subjected to contamination by disease unless the house is cleaned daily.

Ventilation without draughts must be provided. An open space about 6 inches deep and 1 foot 6 inches long midway at the top of the back wall of small houses and for large houses 20 feet long two ventilators each should be 5 feet long spaced at intervals just below the eaves. It is advisable to provide a wooden frame in these apertures to which wire netting may be conveniently attached for protection against vermin. This will ensure satisfactory ventilation by a free circulation of air above the roosts and so avoid direct draughts which may adversely affect the birds.

The interior of the house should be kept dry; *dryness* checks disease. In view of this, water-tight roofs are the first essential and secondly the necessary full protection in all weather conditions would be ensured by overlapping the roof 2 feet in a downward angle forming a verandah in front of the houses.

The most desirable aspect is north, or alternatively north-east and north-west. A northern aspect is generally cosy in winter and cool in summer. It affords the greatest protection from the prevailing adverse weather conditions and permits the maximum sunshine in front of the house during the day, particularly in winter. Sunshine, with access to shade when required by the birds, is an important factor, more important than is commonly realised for maintaining the health of the stock, their productivity and the hatchable qualities of the eggs they produce. Coolness in summer is equally desirable. Exposure to high temperatures and stuffiness sap the vitality of poultry of all classes, resulting in heat prostration. The shade of trees and free circulation of air are perhaps the most practical means of reducing the effects of high temperatures. Anything that is likely to arrest the circulation of air should be avoided, such as the use of grass screens attached to the sides of the runs in summer. If used during the winter months for protection against cold winds they should be removed as soon as possible after the termination of the wintry weather.

Floors.—Another important factor for consideration in the construction of houses is the floor. The floor should be hard and durable; damp floors cause damp litter, and if loose, dry and dusty, they will be difficult to keep clean, in due course becoming heavily infested with fleas, which affect the health and productivity of the stock. Dust irritates the eyes and nasal passages and affects the respiratory organs. The stock housed under such conditions, cannot remain healthy or free from eye and nasal affections, and if fleas are present, the poultry farmer will find that no matter how often they are removed from the heads of the birds others will take their place. The floor if not elevated above the surrounding ground outside will be damp in wet weather, and a damp floor is a precursor of diseases and internal parasites of all kinds. The

floor should, therefore, consist of hard material such as bricks or rubble grouted in cement with smooth surface and no cracks, elevated not less than 6 inches above the ground level outside. It should be covered with dry grass or leaves to a depth of 6 inches to induce the birds to scratch for their grain food for exercise. Floors consisting of rammed antheap and tarred surface are not durable and require periodical renovations, but they are more satisfactory as a temporary measure in preference to floors with a loose dusty surface. Wire and slatted floors are more easily adaptable to portable houses and are usually embodied in the construction of Colony Houses. Wire floors consisting of ordinary netting wear badly, a stronger material is necessary for durability such as wire screening of one inch mesh. Slattered floors for portable houses are quite satisfactory, the pieces of timber for this type of floor should be at least one inch square of suitable length painted with a tar preparation as a preservative measure and attached parallel to one another one inch apart extending from the back to front of the house.

The Runs and Fences.—Enclosures of wire netting are necessary when the stock are kept in the semi-intensive system. The merits of this system are difficult to surpass. The size of the runs is to some extent immaterial; they are desirable to enable the birds to dust bath in the open and to obtain additional fresh air and exposure to sunshine. Runs provide more room for the birds to move about, although they are not intended essentially for exercising, as this is obtained by the birds scratching in the grass litter provided for that purpose.

The size of the runs required for a given number of birds depends on the system under which the birds are to be kept. Large runs are generally not desirable under ordinary circumstances, but large enclosures are useful such as for young stock where free ranging is not practical, or inadvisable owing to losses caused by animal vermin. Duplicate runs moderate in size are preferable to single large runs on a permanent semi-intensive plant for adult stock. They have considerable advantages when the houses and runs are occupied indefinitely as is the case for laying flocks. For single or unattached houses an enclosure of 30 feet square

subdivided in half with the house placed in the centre of the division fence is a good system of arrangement, and for large houses built attached to each other to accommodate the laying flock a run extending 20 feet from the front of the house may be erected with partition fences at the back and front of the houses to coincide with the partition walls. Utilising the pens at the back for three to six months in hot weather and resting these whilst those in the front are being occupied by the birds during winter, thereby confining the stock on comparatively fresh ground at intervals is preferable to one large enclosure to each house. A house provided with duplicate runs should be constructed according to its size with one or two exits (trapdoors) in the walls to facilitate the use of both sets of runs, the trapdoor can be opened or closed depending upon the runs the stock occupy. Whether the wire enclosures are large or small they require attention, they must be kept fresh and clean, and it is difficult to ensure this in single runs when they are occupied continuously for an indefinite period. It is highly necessary to provide shade in the runs. The surface of the runs should be exposed as much as possible to the direct rays of the sun with only sufficient shade for the comfort of the birds during the day. For this purpose the shade of trees is desirable, or as a temporary measure a grass shelter on four uprights could be erected at least 4 feet in height, and trees should be established in the runs as soon as possible.

Material and Design of Houses.—*Material.*—There are many opinions as to the most suitable material to use for the construction of poultry houses, as nearly all materials commonly used have their advantages. A decision is often based on the material which the poultry farmer finds economical and convenient to obtain for the purpose required. The main object is that the construction should be weather proof and durable; with this in view depreciation and the cost of upkeep determine to some extent the economy of any construction and the material to use.

Some materials are less durable than others and necessitate periodical replacement or frequent renovations, these are generally more suited to the construction of small houses, and all of them may be serviceable under some conditions

or in emergencies as temporary expedients. The use of the most durable and serviceable materials for permanent constructions cannot be too strongly emphasised, as makeshifts finally prove detrimental and more costly.

The following materials have been used to good advantage: burnt brick, pisé de terre, Kimberley brick, grass, wood, corrugated iron and treated sacking material.

Burnt bricks are generally available on the majority of farms at reasonable cost; they are most durable and best suited for the construction of permanent buildings. The houses built of burnt bricks as with those constructed of pisé or Kimberley brick should be provided with a good damp-course and the interior of the walls smoothed with lime mortar. Pisé and Kimberley brick houses should be plastered outside as well with suitable mortar to preserve the walls. Houses built of these materials are cool in summer and warm in winter with comparatively little variation in temperature during the day or night. Care should be exercised in plastering to avoid cracks and crevices in which insect vermin, especially fowl ticks and red mite, can find harbourage. Grass houses are considered more as a temporary measure, but if well constructed they are useful for accommodating turkeys and ducks and to some extent as Colony houses. As in the case of grass roofs, the grass should be screened and must be securely fastened to the framework; the framework, without exception, should be covered with wire netting to which the grass can be fastened outside to prevent cats and other wild animals obtaining ingress. Whilst timber must be used in the construction of all houses, suitably prepared timber for the construction of wooden houses in this Colony is usually too expensive and unsuited to the climatic conditions. This material is almost entirely confined to the construction of coops and brooders, for which it is most serviceable. Houses of corrugated iron are easily and quickly erected, but this material is usually costly for the construction of large houses. Being durable, firm and comparatively light, it is more valuable as roofing material and the construction of portable houses. Corrugated iron houses must be well ventilated and not too low in construction. In the case of Colony houses they should be placed where they can be shaded by trees

during the hottest part of the day. Roofs of corrugated iron should be covered with a thin layer of grass or sunflower stalks in the hottest localities if necessary to ensure as even and cool a temperature as possible inside the house.

Another useful material for the construction of cheap light houses is sacking treated with tar or a mixture of cement and lime. A framework of timber is first constructed and over this the sacking, which has been immersed in tar, is stretched tightly and nailed down with broad clout nails; when dry it can be white-washed with lime. A good mixture for treating sacking is as follows:—

Cement ..	12 lbs.
Lime	2 lbs.
Salt .	1 lb.
Alum . .	½ lb.
Water ..	1¼ gallons.

Take the required amount of lime and salt, after stirring well in the water, sieve out the lumps (these should be pulverised and replaced), then add the cement and finally the alum, stirring the mixture thoroughly. A stiff brush should be used for applying the mixture and smoothing it uniformly; before the sacking dries out a second coat of the mixture may be applied to the outside. Subsequent applications of this mixture will strengthen the material.

The Design and Size of Houses.—The design of permanent houses most suitable for poultry is the lean-to pattern with open wire front. A dwarf wall 2 feet high running the length of the house in front is recommended and the roof overlapping 6 inches at the sides and back and projecting in front at least 2 feet bent in a slightly downward angle forming a verandah, which prevents a great deal of rain from driving into the house. The lean-to type of roof is best suited for small and large houses when corrugated iron is used for roofing. Thatched roofs must be either apex-shaped or an uneven span type to obtain the required pitch to readily carry off storm water. The construction of thatched roofs, apex in shape, must of necessity be well elevated and the head

room so provided is often much greater than the birds require. Although thatched roofs are cool in the hottest localities, in some districts the cubic capacity of the interior of these houses might be excessive, causing respiratory troubles amongst the birds, and in which case the uneven span type of roof might be more suitable. The general principle is to provide comparatively low houses for poultry and lean-to roofs should be sufficient in height to enable the attendant to move about easily inside, a maximum height of 6 ft. 6 in. to 8 ft. at the highest point for small and large houses respectively, with an overlap in front as suggested, would meet the requirements for lean-to roofs. Sufficient light and good ventilation can be obtained in large houses by making them comparatively square in shape, and houses with thatched roofs relatively long and narrow; whilst small houses should be square.

The size of houses must in all cases depend upon the number of birds to be accommodated; also the system of housing and purpose for which the houses are to be constructed must have consideration. Whilst overcrowding is detrimental the provision of a greater area in the houses than can be effectively used by the birds increases unnecessarily the operation costs and capital outlay. The carrying capacity of a house is based on the floor area and roosting accommodation. To determine this it is necessary to take into consideration the system of housing to be adopted which in turn is limited to some extent by the most efficient unit or number of birds to house together in one flock, also whether the housing is required for adult or growing stock. A comparatively large flock of adult stock can be provided with less floor space per bird than smaller flocks, because the birds of a commercial laying flock in large houses have a greater area in which to move about. On the other hand the size of the flock should be limited, because large flock units as a rule are not as productive as smaller flocks owing possibly to the increased competition at the food hoppers and the greater opportunity for cumulative action of the more robust and aggressive birds in a given flock. The average egg production generally decreases as the number of birds in any one unit increases in comparison with small flock units. The limitations are, therefore, obvious with regard to the size of

houses to construct, firstly on the grounds of economy and secondly the advisability of increasing the size of flock units unduly in view of the usual decrease in their average production results.

Another important factor which should not be overlooked in deciding the size of flocks to be accommodated in one unit is the provision of sufficient food utensils and nesting accommodation. It will be found that the capacity of a house or number of birds in a given flock can be increased more easily than the required provision for enabling the birds to feed comfortably without molesting each other at the food hoppers, which so often results in overcrowded flocks.

To ensure sufficient roosting accommodation without overcrowding at night, the light breeds, such as Leghorns, must be provided with 6 to 8 inches of roosting accommodation per bird, and in the case of the heavy breeds, such as Australorps and Rhode Island Reds, a minimum of 8 inches and a maximum of 10 inches must be allowed. In cold weather the minimum perching accommodation would be sufficient, whilst in the hot weather the birds will require the maximum amount of room for roosting.

The floor area allowed per bird is governed by the size of flock to be accommodated; as a guide, for flocks accommodated in units up to 50 birds of the light and heavy breeds, $3\frac{1}{2}$ and $4\frac{1}{2}$ square feet per bird should be provided, and for flock units up to 125 birds, 3 to 4 square feet respectively. The most satisfactory unit for commercial laying flocks under ordinary conditions is approximately 100 to 125 birds in the intensive or semi-intensive systems.

System of Housing.—There are three general systems of poultry farming all of which can be adopted to some extent on poultry farms; they are:—

1. The intensive system, in which the birds are kept entirely confined under cover.

2. Semi-intensive system for which houses and wire runs are provided, thus restricting the stock to a given area.

3. Free range, or extensive system by which the liberty of the stock is in no way restricted and sleeping accommodation only is necessary.

These systems have their advantages and disadvantages. They are fortunately adaptable to the circumstances and convenience of the farmer and the stock to be accommodated. They have been found satisfactory in practice on a large scale either combined on some farms and on others as a specialised system. As a general rule in this Colony the commercial laying flocks are controlled by confining them in the intensive or semi-intensive system which are recommended for adult stock, but for the growing stock free ranging on an area of land set aside for that purpose is recommended. The young stock can be raised in the semi-intensive system if the land available is limited. On some farms where only a few birds are retained for household purposes the free range system generally meets the requirements, but this system cannot be recommended as a suitable plan for adult birds on a commercial basis.

The most suitable housing system for poultry as variously practised, such as plot-holders with a limited number of birds and poultry farmers on areas permitting the establishment of a commercial poultry plant are as follows:—

Suburban House and Run.—There is no reason why a plot-holder should forego a few laying hens on account of a flower or vegetable garden, and much less why a backyard poultry house should be an eyesore in attractive surroundings. Often one hears the remark "It is impossible to keep a garden and fowls." A system to overcome this impression has been included in this article for those who are fortunate in possessing a plot and who wish to maintain a garden and a few fowls in a limited area. By this system the birds can be given access to four runs during the year, the productive value of the land will be improved without the additional cost of fertilisers and destructive insect life would be suppressed. Indeed, valuable material would be accumulated for composting and applying to other vegetable growth, such as lawns and flower beds, whilst a supply of new laid eggs could be available at comparatively little cost to such householders.

The site set aside for the poultry and vegetable garden should be enclosed with a wire netting fence, and the house placed in the centre of this enclosure with the front facing North. From each corner of the house a length of netting is extended at right angles in a straight line and attached to the sides of the enclosure opposite (Fig. 1). This provides four pens, in each of which the birds can have access alternately for a period to suit the owner, one run being occupied by the birds while vegetables are grown in the other three enclosures. The manuring and aeration of the soil in the runs occupied by the birds tends subsequently to produce excellent crops free from insects and grubs. The fact that fresh ground at least four times a year is available for use by the birds, together, of course, with proper care and attention to cleanliness and feeding, ensures the health of the stock and the production of eggs. It is not suggested that an attempt should be made to hatch and rear chickens under these conditions, as the limited land available and trouble entailed may not warrant this. It is recommended that the stock should be culled each year as their production ceases on moulting and replaced by a similar number of young pullets purchased from a reliable breeder of a good egg-producing strain. Under these circumstances a male bird would be unnecessary.

A poultry house 8 ft. square would accommodate a maximum of 20 birds, the roof 6 ft. 6 in. high in front and 6 ft. at the back with a door 2 ft. wide in front. A dwarf wall 2 ft. high should be provided extending the length of the house to the door and the remainder of the front enclosed with wire netting of 2 inch mesh and 4 feet wide. The door should consist of a light wooden frame 1 in. by 2 in. material well braced and covered with wire netting. At the back of the house and both sides an exit 1 ft. square with a sliding trap door to each run should be provided, and as in the case of the wire door they should be placed at a suitable height above the level of the litter inside. The trap doors should be well fitted to avoid draughts.

The house should be constructed of brick with a corrugated iron roof. The front enclosed by wire netting and a wire door to keep the birds confined when necessary in wet

weather and ensure their safety at night. The floor should be hard, preferably bricks grouted in cement mortar, and when the house is occupied cover the floor with grass or dry leaves in which the birds can exercise to obtain their grain food. A dropping board 2 ft. 6 in. wide and 2 ft. off the floor is necessary and two perches, nest boxes and food utensils should be systematically arranged in the interior of the house elevated above the floor. Absolute cleanliness is necessary. Supply succulent green food such as waste vegetable leaves daily in addition to their other food requirements, mash, grain, oyster shell, grit and fresh clean water.

Breeding Pen Houses.—A small type of house is required for breeding pens to facilitate pedigree work. Either separate houses with runs or a number of houses may be constructed attached to each other in an unbroken line. Attached or continuous houses require less land and are more economical to construct and equip with the necessary utensils. A suitable size for the single or attached system of housing is 8 ft. square (inside dimensions), 6 ft. 6 in. high in front and 6 ft. at the back. It would be found convenient in the case of attached houses to provide a wooden door 2 ft. wide in the back wall of the house at the end of each compartment in which case the house should be 8 ft. deep with partitions 10 ft. apart. The door in the back wall replaces the usual wire doors in the fences, but a wire door is required in the front of the house for access to the runs and in which a trap door should be provided as an exit for the birds into the runs. With the doors so arranged there would be less likelihood of the breeding stock becoming mixed. In the case of separate houses the best position for the wire door is in front of the house. The house should be of the lean-to pattern if the roof is corrugated iron. The walls should be built of burnt brick or some other suitable material at the disposal of the poultry farmer. A greater pitch in the roof would be necessary in the case of thatched roofs. The front should be open wire fronted. When a number of breeding pens are required it would be more economical to construct long houses suitably divided into the required number of pens. The semi-intensive system is recommended for the breeding pens, and a run for

each house in front must, therefore, be provided (Fig. 2). Double sided hoppers could be arranged as in the case of the laying houses in the division walls.

Laying House.—The advent of the large laying house has to some extent made commercial poultry farming an economical and practical proposition both by greatly reducing the cost of labour and accommodating a much larger number of birds in a given area than previously had been thought possible. Such houses may be built in pairs or attached to each other embodying several pairs and they are adaptable to the intensive or semi-intensive systems. For economical reasons the construction of laying houses should be planned on the continuous or attached system. The houses may be continued unbroken for quite considerable lengths if desired upon a suitable site with partitions as required for subdividing the flock into the required number of units. To prevent draughts sweeping through long houses from end to end solid partition walls are necessary at intervals, and for this it is desirable that alternate partitions should extend from the back walls to the front, and those between them should be long enough for protecting the birds whilst roosting, that is the width of the dropping board. A solid wall extending 5 ft. 6 in. from the back wall is recommended with a dropping board 5 ft. wide for four rows of perches. The wall being built up from the floor to the roof and a dwarf wall 2 ft. high is continued for the remainder of the width of the house upon which the food hoppers are placed. This would afford the necessary protection to the birds at night. Good ventilation would be secured by providing apertures in the back wall below the eaves. There are several types of roofs that may be used for laying houses; in all cases the slope of the roof must be the main consideration. It must be sufficient to carry off the rain water. The lean-to type is generally the most convenient and satisfactory to construct. The accompanying illustration is a design to meet the requirements of poultry farms operated on a commercial basis. A house 17 ft. deep divided into sections 20 ft. long for accommodating units of 100 laying birds. (Fig. 3.) A door in the partition walls 2 ft. 4 in. wide is necessary and the utensils and dropping boards should be elevated off the floor to provide the required floor space for this number of birds. For larger flocks the

depth of the house should be increased to 18 ft. or 20 ft. as required, with five perches 12 inches apart; and additional hopper accommodation would be necessary such as the trough type of mash hopper.

The perches should be arranged parallel with the back wall, placed on a dropping board. The dropping board should not exceed 5 ft. 6 in. wide along the back wall, elevated 2 ft. 4 in. from the floor of the house. The perches are supported on 3 in. x 2 in. timber 5 ft. 6 in. long, the latter placed crosswise at intervals of approximately 5 ft. apart on the dropping board. This will provide 4 or 5 rows of perches a minimum of 12 inches apart, leaving a space in front at the edge of the dropping board for the birds to alight on.

The food hoppers and nest boxes should be systematically and conveniently arranged in the interior of the houses. Double-sided self-feeding hoppers should be placed in the division walls from which two flocks could feed, and battery nests should be placed along the alternate partitions in each section of the houses; the water vessels if placed on a stand in the centre of the building would be the most suitable position. By providing apertures in the back wall below the eaves good ventilation will be secured.

Colony Houses.—The term colony house is applied to small poultry houses used for flocks of birds under free range or semi-free range conditions. Colony houses may be portable or fixed buildings and the stock allowed access to field conditions or large enclosures such as an orchard for ranging as the principal object. Under this system the birds are housed in small flock units as a rule, and the houses are systematically arranged at suitable distances apart over the area set aside for this purpose.

Adequate sleeping accommodation only is required, and unless permanent buildings are better adaptable to the conditions portable houses generally prove to be the most satisfactory type. A permanent house 10 ft. deep and 15 ft. long with three perches would accommodate 50 to 60 birds of the heavy and light breeds respectively. Dropping boards could be dispensed with in this type of house, but a good floor is

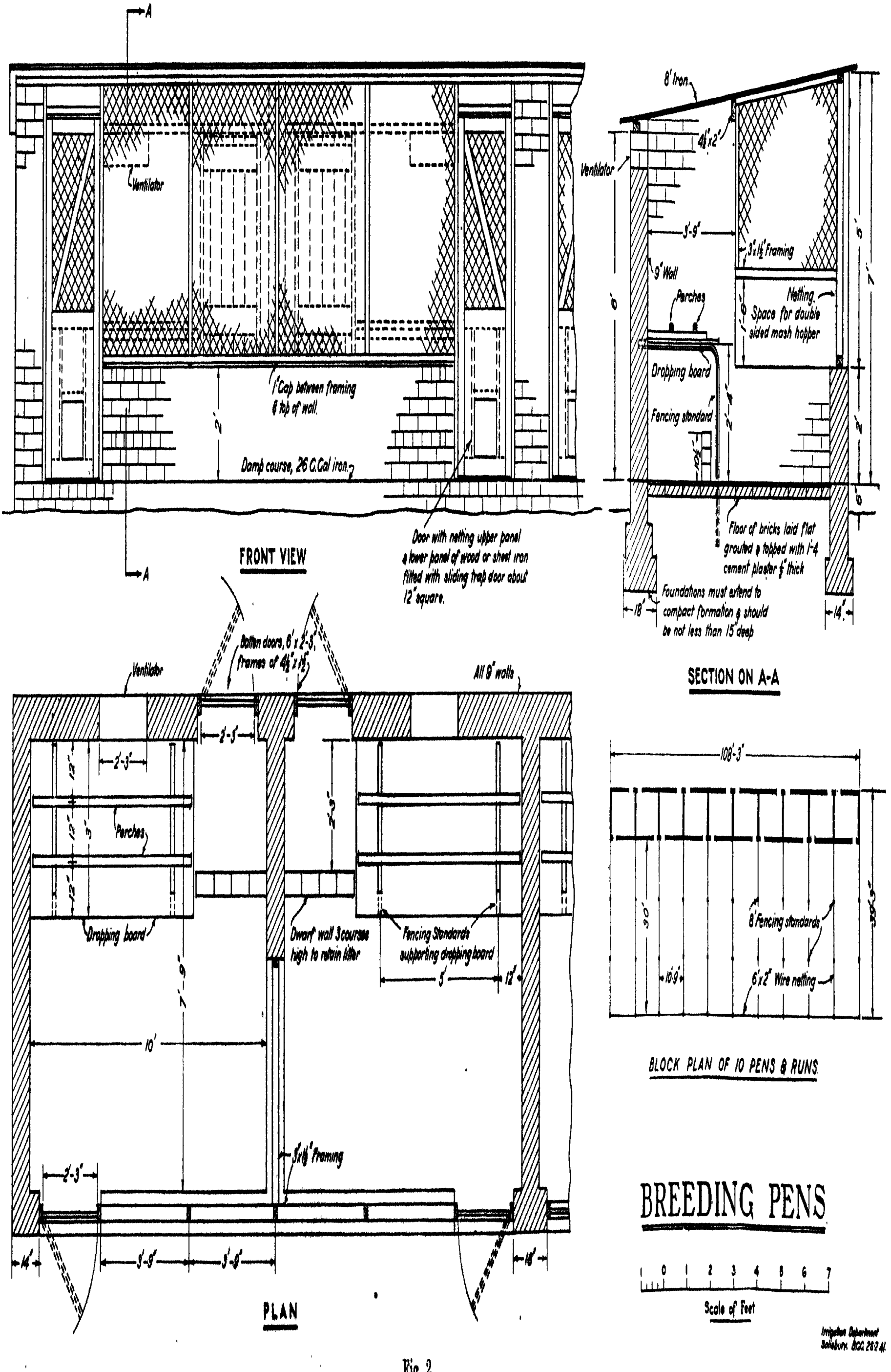

FRONT VIEW
Ventilator
1" Gap between framing & top of wall.
Damp course, 26 G. Gal iron.
Door with netting upper panel & lower panel of wood or sheet iron fitted with sliding trap door about 12" square.
SECTION ON A-A
8' Iron
Ventilator
9" Wall
Perches
Dropping board
Fencing standard
Netting. Space for double sided mash hopper
Floor of bricks laid flat grouted & topped with 1-4 cement plaster ⅝" thick
Foundations must extend to compact formation & should be not less than 15" deep
PLAN
Batten doors, 6' x 2'-3", frames of 4½" x 1½"
All 9" walls
Perches
Dropping board
Dwarf wall 3 courses high to retain litter
Fencing Standards supporting dropping board
BLOCK PLAN OF 10 PENS & RUNS.
8' Fencing standards
6' x 2" Wire netting
BREEDING PENS
Scale of Feet
Irrigation Department Salisbury

Fig. 2.

necessary having a smooth durable surface which should be swept clean daily. Portable houses with wire screening or slatted floors are labour-saving, and when required the stock could be moved to fresh ground. Housing the stock in portable houses is necessary when it is desired to facilitate the fertilisation of land such as cultivated fields or an orchard, which can be done systematically to greater advantage than by the use of fixed houses.

Portable houses should be light enough to move about without difficulty either carried or transported by means of a sleigh. Such houses are generally made of corrugated iron or other roofing material, apex shaped 6 ft. square at the base. They are more suitable for the accommodation of young growing stock in flocks of 50 birds, also fewer male birds and special breeding pens on range. The Colony system for rearing growing stock does not require fencing or runs and they can be moved to new ground each year if necessary. Birds when placed on free range must first become accustomed to their own quarters, and if the houses are spaced about 200 ft. apart little difficulty would be experienced by overcrowding at night in some houses more than others after ranging together during the day. For laying stock on free range a similar type of house could be used, but they should be larger and fitted with nests built in at the sides or back of the houses to have them self-contained. Large portable colony houses should be constructed in sections and bolted together when assembled. They can be conveniently dismantled in sections which makes it easy to move them.

Internal Arrangements.—The interior arrangements of all poultry houses should be neat, convenient, easy to clean and detachable. The equipment should be similarly arranged in all houses of the same type, which facilitates observation and simplifies to some extent the daily routine duties connected with good management. The requisite number of nests, perches and food utensils should be supplied for the number of birds accommodated in each unit.

Nests.—There are a number of different nesting arrangements adopted on farms, some of which are quite unsuitable. As a general principle the nests should be cool and ventilated without exposure to the direct rays of the sun. The nests

should be comfortable, easily accessible and the entrance to the nests should be fairly well secluded. The hens will readily seek such nests, and if sufficient in number there is less risk of egg breakages and of the habit of egg eating, a tendency often resulting from the supply of too few nests. The birds will resort to laying outside in the floor litter or otherwise steal their nests if the nests provided are insufficient or unattractive to them. The nests should be roomy, comfortable and adequate in number for each flock. The two most suitable systems for commercial laying flocks are battery nests which are placed along the side or division walls or arranged in single rows on top of the front wall. Each nest should be at least 10 inches wide, 11 inches high and 15 inches deep to meet the requirements of both heavy and light breeds. The number of nests to provide for large flocks should be the equivalent of one nest to five or six birds and for small flocks one nest to three birds.

Nesting and Broody Coop Unit.—The accompanying plan, *viz.*, Fig. 3, gives details of a very compact and convenient system. It consists of a light frame having two tiers of nests and a broody coop. Each flock would be self-contained by the provision of a broody coop as illustrated. The batteries may be any convenient length, but it is inadvisable and generally unnecessary to exceed two tiers. An alighting board should be provided in front and the batteries can be equipped if desired with trap nests, such as the Venetian blind type of trap front or other similar type requiring a small radius for its operation. The roller type of trap front requires a more deeply constructed nest. When the batteries are used without trap fronts it would be advantageous to provide some means of closing the nests at night, such as a shutter hinged on the lower side in front which could be arranged also to serve as an alighting board during the day when the birds have access to the nests for laying. A shutter as suggested is often necessary to prevent the birds from occupying the nests as they will do during the night for roosting. It is characteristic for roosting birds to occupy the highest accessible positions for protection at night time. The domestic fowl retains this characteristic, and it is on this account that they will often resort to elevated positions in the house if higher than the perches, and that makes it neces-

sary, in the case of battery nests, for them to be finished off with a slattered top with sufficient slope towards the front to prevent the birds roosting there. The space can be used to the greatest advantage under the circumstances by equipping it as a broody coop.

Nests in the Walls.—Nests are sometimes provided in the front or side walls of poultry houses, *viz.*, Fig. 3. They are either built in during the construction of the front wall, or detachable batteries of eight or ten nests in sections can be provided of wood to fit on the dwarf wall in front in a single row for permanently built brick houses. Such nests are more conveniently arranged in the back or side walls for laying stock housed in the apex type of house. The nests in this case may be arranged to project from the walls outside and may be provided with a hinged lid for easy access when collecting the eggs. The provision of nests in the walls is generally not practicable to the best advantage for large flock units owing to the limited space available in which to arrange them. Whilst this system is more suitable and convenient for apex houses, the nesting and broody coop system will be most satisfactory for all other types of houses, whether for small or large laying flocks.

Roosts.—Roosting is a natural habit of fowls at night and is soon resorted to by chickens. The example set by a few older birds running with a flock of chickens, for instance, will quickly encourage them to roost when required to do so. The chickens when drafted from brooders to houses in large numbers will generally crowd together in the corners at night and mortality may be the result. It is advisable at this stage in cold weather to take precautions, in order to minimise this possibility, of rounding off the corners with a wire netting screen triangular in shape to fit into and across the corners at the back with protection temporarily provided by a hover will give them the necessary cover overhead. A wooden frame or hover with hessian or sacking attached should be elevated 2 ft. from the floor under which the chickens would sleep until they are hardened off. Chickens will show a tendency to roost at 10 weeks old, or as the weather becomes warm they will spread out on the litter on the floor of the house. Another good system is to provide broad perches

attached to a portable wooden frame placed on the floor of the house if found desirable to encourage them to roost at this early stage, which will prevent crowding or bunching together on the floor. Such chicken perches are not necessary in the case of houses which are equipped with wire floors. The breastbone of chickens is likely to become disfigured if they are allowed to roost too early on narrow circular perches. The perches for chickens should be flat and not less than 3 in. wide—the length of the breastbone. Well-grown stock can be allowed to roost with safety when four months old or on being transferred to their permanent laying quarters. Dropping boards must be covered on top with a thin layer of sand which should be replaced at weekly intervals. The dropping boards should be wide enough for the number of perches required, and should extend the whole length of the back wall 2 ft. to 2 ft. 4 in. from the floor and project at least 6 in. beyond the front perch. A concrete platform 2 in. thick makes an ideal dropping board for permanent houses at little cost. The perches for adult stock should be 2 in. by 3 in. material, with the broad side up and the corners slightly rounded off. All perches should be placed on the same level supported by cross pieces of timber 3 in. high on the dropping board. Slots in the cross pieces wide enough to insert the perches would hold them in position and are easily detachable. They should be placed lengthwise or parallel to the back wall, the first perch being 12 in. from the wall and the second and successive perches 12 in. to 14 in. apart from centre to centre. The number of perches required will be determined by the number of birds to be accommodated. It is generally sufficient to provide a minimum of 8 in. of perching per bird.

Litter.—The floor of the poultry house should be hard and dry and covered with clean grass or litter of some kind 4 in. to 6 in. deep. The chaff after threshing oats, wheat or rye makes the best litter, but if it cannot be obtained, veld grass, dry leaves or even sawdust when procurable may be used. As the litter becomes soiled or pulverised, dusty or damp it should be taken out and replaced by fresh dry litter. Under ordinary conditions it is necessary to renew the litter at

intervals of 3 to 6 months, but it would be desirable during that period to replenish the litter from time to time to keep the floor well covered.

Broody Coops.—A broody coop is indispensable where the general purpose or heavy breeds are kept. For convenience a coop should be provided in the laying houses such as at the top of battery nests. A wooden frame enclosed by wire netting and having a slatted floor is the most humane and simplest method of dealing with broody hens. Broody coops should be otherwise placed under cover elevated off the floor or provided with a weatherproof top to protect the inmates during wet weather if left outside in the shade of trees.

The Dust Bath.—Fowls will dust bath or wallow in moist earth on account of its cooling effect on them and for the suppression of lice, preferably in the shade of trees. It is a natural habit by which they are able to control and eliminate from their plumage insect vermin, and for this reason the dust bath may be regarded essentially as a bath tub for fowls. A dust bath to meet the requirements of the birds must be damp and friable; preferably located in a partially shaded position it would have the most desirable cooling and cleansing effect. The soil in its natural state, apart from being kept loose and damp in dry weather, should not require further treatment such as the addition of disinfectants or wood ashes, which is supposed on occasions to make it more attractive and effective for the birds. A partially shaded damp soil has the greatest attraction to them and the soil must be friable enough to penetrate the feathers to the skin. If the birds are compelled to dust bath in soil which is dry and dusty their eyes and nasal passages are liable to be affected and the bath has little or no effect on external parasites such as lice. Soil which might be adhesive when damp would be improved by the addition of a reasonable quantity of natural ground limestone. For flocks in the intensive system in which the birds are not provided with runs or free range conditions, provision must be made for them to dust bath in the interior of the house. When the birds are deprived of their dust bath or confined in cages for some time, they must be treated individually with insect powder and, possibly, the more laborious system of having to dip the birds to free them from external parasites.

Catching Crate.—When it is necessary to catch or handle laying birds for the purpose of culling, grading or transferring them, a catching crate is an indispensible and convenient labour-saving device (Fig. 4). The coop should be 5 ft. long, 2 ft. wide and 2 ft. 6 ins. high (outside dimensions) consisting of a wooden frame enclosed with wire netting and a boarded floor. A sliding door of slats should be provided at one end and two hinged wire doors on top. In using the coop, the end with the slatted door exit is placed firmly against the trap door of the poultry house; the birds are then quietly encouraged into the coop, when full the sliding door is closed. The birds can then be moved to the place desired. If the birds are to be handled individually they may be caught one by one through one or other of the hinged doors on top of the crate. The crate must be narrow enough to pass through the gates in the wire fences of the runs. By having available two or three of these crates time and labour will be saved in handling the flock.

Utensils and Equipment.—Periodical attention to all equipment would be well repaid. The utensils, perches and floors of the houses should be kept in good repair and clean by occasionally disinfecting as a precaution against failure that might be caused by insanitary environment. The water vessels should be cleaned regularly and washed in a weak antiseptic solution once a week. The drinking water should not be allowed to become stagnant or contaminated by filth of any kind, and sun warmed water is likely to cause bowel trouble. Neglected perches and food utensils may become infested with disease and insect vermin followed by disorders of all kinds. All wood work, such as nest boxes and perches, should be painted with some tar preparation at least once a year. The dropping boards should be cleaned daily whenever possible; an accumulation of manure should never be permitted on the dropping boards. It is a good practice to brush the walls twice a year and whitewash them, also disinfect the floor once a year. In all cases the houses and runs should be as clean and neat as possible, nothing looks worse than a neglected plant with dirty, untidy houses and runs, standards crooked, sagging wire netting and dilapidated gates. It has generally been observed that the poultry plant of successful and progressive farmers is clean and in good

repair. All utensils for milk, water and mash should be simple, neat and easily kept clean. Excellent utensils can be made from petrol tins and boxes at little cost. The food hoppers and nest boxes should be systematically and conveniently arranged in the interior of the houses and the birds must be provided with ample room in which to feed and lay. As a guide the hopper and nesting accommodation should be based as follows: Allow one inch per bird of mash hopper space and half-inch for drinking water, at least one nest ten inches wide for six birds and 2 feet of grit and shell hopper space for 100 birds.

(To be continued.)

HE KNOWS.

Who was the successful farmer who was overheard to say that it is so difficult to keep an eye on cleanliness? His argument is that when cleanliness is there, you can't see it for crops.

Cleanliness Aids Insect Control.

Veterinary Notes.

BRUISING IN SLAUGHTER CATTLE.

By A. McGILP, M.R.C.V.S.

Bruising in slaughter cattle is a source of great loss both to the producer and the butcher, particularly to the former. The condition is much more prevalent than many people are aware, and the number of carcases showing bruising is increasing each year. The severity of the bruising varies a great deal, some being very superficial causing no more than a mark on the carcase, whilst others may be so bad that the whole carcase has to be condemned as unfit for human consumption.

Bruises and contusions when localised and unaccompanied by other changes do not diminish the value of the whole carcase from a meat inspection point of view, but when the bruised parts are removed, as they must be, the carcase or part thereof, is mutilated and is thus rendered unfit for export. This means that the carcase or quarter affected has to be used for the local market, when it brings a smaller return to the producer, particularly if he is paid on a weight and grade basis.

The writer is of the opinion that a considerable amount of bruising could be prevented by the exercise of a little foresight, and a great deal of care and patience on the part of all those who are concerned with the handling of cattle in the process of having them removed from pasture or feeding pen to the abattoir.

The various ways in which an animal may receive bruises and their prevention will now be discussed.

There can be no doubt that the chief cause of bruising is poking or horning by other cattle. This cause could very easily be removed, and this is where foresight comes in. All

animals intended for beef purposes should be dehorned as calves irrespective of sex. By using the caustic stick this becomes a very simple operation, and the writer knows farmers who have taught an intelligent native to dehorn young calves by this method. Dehorning at this age may be carried out systematically with little or no extra work, as the calves, as they come on, can be done on dipping days when all cattle are rounded up in any case. In the case of native-owned cattle the "dip boy" could easily be taught to carry out this operation. Older cattle may also be dehorned by various methods, but many owners object to dehorning adult cattle because of the danger of screw-worm infection.

"Tipping" can, however, be done with older animals without any danger. This operation consists of cutting a few inches off the tip of the horn, thus removing the point and so reducing poking to a minimum. It is well known that animals whose horns have been tipped are less disposed to poking than others in the herd, the horns of which have been left untouched.

Those who go in for stall feeding of bullocks should realise that losses through rejects are in store for them if they are feeding horned steers. Bruises received in the feeding pens are responsible for numerous rejects and even condemnations. If one producer has a number of rejects and/or condemnations, it may mean a lot to him financially, as instead of the profit he had hoped to make on his feeding operations he may find himself with a deficit.

Apart from bruising by horning being prevented, feeders would find that dehorned steers fatten much more quickly. The reason is obvious. Polled animals settle down quickly together, there is no domination by one or two which have longer or sharper horns, as is the case when horned oxen are being fed, and the other oxen do not have to be continually moving about the pen to keep out of the way.

Experienced feeders know that cattle put on weight more rapidly with the minimum of exercise.

Feeders who suffer losses through rejects for bruising and fail to realise the true cause may adversely influence prospective feeders.

Another cause of bruising is injuries received in the cattle race when branding or culling prior to despatch to sale yard or abattoir. The majority of races are much too wide. The race should be wide enough to hold the beasts comfortably without enabling them to turn round or make much lateral movement. Suitable dimensions are 11 inches wide at the bottom, 3 feet 6 inches wide at the top and 5 feet high. Each race should be fitted with a bale at the exit so that an animal can be secured without injury. The animals should be driven quietly into the race when they can be handled with the minimum of trouble, and bruises on shoulders and/or hips will be conspicuous by their absence when the carcases are dressed.

Bruises may also be received at the siding when cattle are being loaded for transport by rail. This is the time when patience must be exercised. Natives, and I may add some Europeans, should be taught that cattle do not respond to shouting and blows nearly so well as they do when everyone goes about his job quietly and endeavours to drive the cattle into the truck without causing them to become unduly excited. In many cases where the loading of cattle has been witnessed the combination of the voices of European overseers and natives, the barking of kaffir dogs, the cracking of whips and the bellowing of terrified cattle awoke the echoes for miles around. In cases such as these the frightened animals rush about colliding with every projection and obstacle with the result that when these cattle come to be slaughtered bruising will be found to be widespread. All good stockmen will agree that patience is a virtue where cattle are concerned. Shouting, whip cracking and other noises are totally unnecessary and nearly always have the opposite effect from that which is desired.

Cattle can be handled in a noisy manner with success if the well-being of the animals is only of secondary consideration and time is no object.

Care should be taken that trucks are not overloaded. It is better to leave one animal at home than run the risk of injury to the others. The Railways have helped to minimise bruising in transit by the provision of padded cattle trucks.

Bruises may also be seen in carcases from animals which have arrived at the abattoir by road. These usually take the form of weals, which suggests that they have been caused by sticks or whips. These are, as a rule, not serious from a meat inspection point of view, but may be responsible for the carcase being put in a lower grade than its condition warrants.

Native drovers should be encouraged to "drive with care" and the use of sticks and whips should be looked on with strong disfavour or prohibited entirely. Admittedly the latter course would be very difficult when dealing with natives.

Bruising may be caused by accidents, such as an animal getting down in the truck and being trampled by the others. These cases are rare and are unavoidable, except when animals in poor condition are concerned, and these should not be trucked.

Bruising may, and does, occur at the abattoir pens, but is mainly due to poking or animals being thrown against the side of the pen by others. "Wild" animals get bruised at this stage, as unfamiliar surroundings often cause them to run amok. Apart from these cases the amount of bruising which occurs at the abattoir is negligible, and when I make that statement I am referring to the abattoir of the Cold Storage Commission.

Every producer should make a point of seeing that his cattle arrive at the abattoir free from blemishes, as apart from the monetary loss to himself, nothing is more annoying than to see the carcase of a really first-class bullock spoiled by unsightly bruises, especially when these could have been avoided by the exercise of a little care.

Although "April Fool" comes once a year, you can be fooled throughout the year by crop pests that maintain their existence in plant refuse and in weeds.

Cleanliness Aids Insect Control.

Rhodesian Milk Records.

SEMI-OFFICIAL.

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B. Fat in lbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Rongo	G. Friesland	8377.90	249.28	2.98	300	J. A. Baxter, Glen Norah, Salisbury.
Iris	G. Shorthorn	6095.70	211.72	3.47	300	J. R. Bedford, Poltimore, Marrandellas
Mutsigana	G. Guernsey	5543.60	202.47	3.65	300	
Quilts	G. Friesland	5931.70	252.10	4.26	300	
Rosie	G. Friesland	6220.50	223.55	3.60	300	
Bolt	G. Friesland	7550.50	270.53	3.58	300	Boyd Clark Est., Castle Zonga, Inyazura.
Carpet	G. Friesland	5919.50	224.26	3.79	300	
Dolly	G. Friesland	6134.50	215.42	3.51	300	
Zonga Elsa	P.B. Friesland	6291.50	216.26	3.44	280	
Ginger	G. Friesland	8126.00	278.68	3.43	300	K. M. Campbell, Hedon Farm, Marandellas.
Peggy	G. Red Poll	7028.00	295.49	4.20	300	
Africa	G. Friesland	8752.30	294.05	3.36	300	Hon. H. V. Gibbs, Bonisa, Redbank.
Dolly	G. Friesland	5968.70	205.52	3.44	299	
Fatty	G. Friesland	5954.30	212.22	3.56	300	
Hazel	G. Friesland	8967.80	330.22	3.68	300	
Molly	G. Friesland	7904.00	234.40	2.97	300	
Whinburn Zephyr	Friesland	6662.80	213.72	3.21	300	
Hartie	G. Friesland	6218.00	204.38	3.29	300	F. B. Morrisby, Sunnyside Gwelo.
Whinburn Echo	Friesland	6882.80	228.06	3.31	300	Major R. R. Sharp, Whinburn, Redbank
Audrey	G. Angus	4990.60	204.44	4.10	260	A. H. MacIlwaine. Larkhill. Marandellas.
Larkhill Blackcurrant	G. Red Poll	5862.00	209.98	3.58	238	
Larkhill Prunella	G. Red Poll	5812.00	243.94	4.20	291	
Gamble	G. Ayrshire	5395.50	233.81	4.33	300	F. H. R. Maunsell, Forres, Bromley.
America	G. Friesland	6541.20	303.28	4.64	300	Red Valley Est., Lushington, Marandellas.
Chikoopo IV.	G. Friesland	7120.90	290.88	4.08	300	
Jerry II.	G. Friesland	5836.70	228.49	3.92	300	
Mandippa II.	G. Friesland	7452.20	243.87	3.27	303	
Polly Pike	G. Friesland	6646.30	250.22	3.76	300	Red Valley Est., "P" Herd, Lushington, Marandellas
Porridge	Friesland	6107.40	215.70	3.53	300	
Potash	G. Friesland	7247.10	265.97	3.67	300	

Southern Rhodesia Veterinary Report.

FEBRUARY, 1941.

DISEASES.

Anthrax was diagnosed on Section 8, Liebig's Ranch, in the Chibi native district.

TUBERCULIN TEST.

Eighteen bulls and eighteen heifers were tested on importation. There were no reactions to the test.

MALLEIN TEST.

Seven horses were tested, with negative results.

IMPORTATIONS.

Union of South Africa.—Bulls, 16; cows, 8; horses, 3; mules, 24; sheep, 843; pigs, 27.

United Kingdom.—Horses, 1.

Belgian Congo.—Mules, 16.

Bechuanaland Protectorate.—Sheep, 536.

Northern Rhodesia.—Horses, 2.

EXPORTATIONS.

Portuguese East Africa.—Slaughter cattle, 40; sheep, 145; pigs, 36.

EXPORTATIONS.—MISCELLANEOUS.

In Cold Storage.

To United Kingdom.—Beef quarters (chilled quality), 6,984; tongues, 14,855 lbs.; livers, 31,348 lbs.; tails, 8,415 lbs.; skirts, 5,212 lbs.; tongue roots, 1,789 lbs.

Northern Rhodesia.—Beef carcases, 285; offal, 10,531 lbs.

Belgian Congo.—Beef carcases, 136; pork carcases, 80; offal, 559 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa.—Corned beef, 238,356 lbs. beef fat, 1,000 lbs.; meat paste, 293 lbs.; sausages, 528 lbs. beef and vegetable rations, 21,720 lbs.; lunch rolls, 1,620 lbs. beef and ham rolls, 936 lbs.; tongues, 600 lbs.; hams, 388 lbs.

To Northern Rhodesia.—Meat meal, 4,000 lbs.; bone meal, 2,000 lbs.

To Belgian Congo.—Corned beef, 900 lbs.; sausages, 189 lbs.; tongues, 180 lbs.; meat meal, 2,000 lbs.; bone meal, 30,000 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA
Locust Invasion, 1932-40.

Monthly Report No. 99. February, 1941.

Red Locust (*Nomadacris septemfasciata*, Serv.).—Very few reports of locusts have been received during February.

Hoppers have appeared in apparently small to medium bands in the districts of Mtoko, Chilimanzi, Matobo and Melsetter, and have been, or are, being dealt with. Hatchings have also occurred in the Chibi district but remote from habitation.

Some damage to crops has been reported in one district.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

Vol. XXXVIII.] No. 5 [May, 1941

Editorial

Notes and Comments

Waterlogging and Alkaline Soils.

Waterlogging was mentioned by a correspondent recently as one of the growing evils of Rhodesian agriculture. The picture may or may not be exaggerated, but there is no question of its seriousness. Waterlogging may be of two kinds. It may be due to a rise of the water table, or to impeded drainage of surface water, or both. It is accompanied almost always in tropical and semi-tropical countries which have a long dry season by an accumulation of alkaline salts. If tackled early it is easily cured; if neglected, particularly in the more arid regions, it can only be remedied with great trouble and at considerable expense. The drainage may be impeded by fine clay particles blocking up the pore spaces, and this is liable to occur when run-off water carrying considerable quantities of clay, runs into natural depressions. The heavy black vleis probably developed in this way. Badly supervised irrigation in which the rushing irrigation water picks up heavy amounts of clay may have in time the same deleterious effects on the irrigated land. Irrigation is the chief cause of waterlogging, because of the application of water in too heavy amounts, so raising the water table, or because of an impervious layer, or because of harmful sodium salts in the lower depths, which are brought to the surface on drying. The process is a vicious circle. Irrigation is used in arid regions, but in arid regions sodium salts are liable to occur because either they have not drained away or they have been brought to the surface by capillary action. Sodium salts have an exceedingly bad effect on the soil,

making it hard, compacted and impervious. They menace all irrigation projects which have not been carefully planned or which are not scientifically controlled. Alkaline conditions are brought about by irrigating with alkaline water, by blocking the natural drainage, by excessive evaporation and high temperatures, by bad natural drainage, by faulty irrigation practice, and by absence of enough rain to wash out the alkaline salts.

All land which it is intended to irrigate should be carefully examined to some considerable depth, at least 4 feet, to see that there is nothing likely to interfere with drainage. The lower layers of the soil and the irrigation water should be analysed to see that they are free from harmful salts. The land should be contour ridged and protected, and finally irrigation should be practised with extreme care to see that the soil receives enough moisture, but not too much.

"Kapok."

Recent correspondence with the Medical Superintendent at Ngomahuru has indicated the possibility of growing the Kapok tree successfully in Southern Rhodesia.

Trees planted at Ngomahuru, south of Fort Victoria, have reached a height of 40 to 50 feet in seven years and a small percentage started to fruit at the age of five years. This tree, the wood of which is believed to be valueless, is grown for the floss surrounding the seeds which are enclosed in a large capsule. It does not appear to require a high rainfall, but will not stand frosty conditions and needs a warm climate. Parts of the Sabi Valley would probably be suitable for its requirements.

A considerable quantity of Kapok is imported annually into the Colony and is used largely in upholstery. The trade returns unfortunately include Kapok and "flock" under one heading, but the amount so imported in 1939 was 34,898 lbs. worth £768 at port of shipment, while during 1940 it amounted to 51,892 lbs. worth £1,798.

The Forestry Division expects to have a small quantity of seed available shortly and is prepared to distribute samples to farmers in suitable areas.

Lucerne.

A big drive is being made in New South Wales for the more extensive growing of lucerne, and the *Agricultural Gazette* of February 1st contains numerous articles on the vital part which lucerne can play in the farm economy. One of the outstanding features of lucerne is its ability to recover rapidly after a protracted drought, and to supply excellent grazing well ahead of the natural pastures, or any annual-sown catch crop. It is specially recommended in New South Wales for growing in wheat lands, where it restores fertility and checks erosion. Lucerne is a crop which is entitled to as much care and attention as wheat, though it does not always get it. Lucerne does best in a frieble loamy soil in which it can root deeply. It is not tolerant of acidity and requires a soil well stocked with bases, especially lime. It should receive dressings of superphosphates. Lucerne will maintain stock in good condition all the year round, and well managed lucerne areas provide efficient fire breaks to standing crops.

Government Notice No. 181 of 1941.

The regulations published in Government Notice No. 181 of 18th April, 1941, contain nothing that has not previously been provided for. They bring together all the regulations in force under Part II. of the Tobacco Pest Suppression Act, which deals with growing tobacco.

The following are declared pests under this part of the Act:—

Tobacco White Fly, Tobacco Leaf Curl, Tobacco Rosette, and the virus causing Kromnek of Tobacco. Because dahlias are common hosts of the virus causing Kromnek, the dahlia is declared to be an alternate host of a pest of growing tobacco.

The fixed date by which the Turkish crop refuse and alternate hosts on Turkish lands are to be uprooted and destroyed is the first day of September in each year. The corresponding date for the crop refuse of other types of tobacco and for alternate hosts on their lands is a month earlier, namely, the *first of August.* Some other cleaning

measures, not the subject of regulation but imposed directly by the Act, were referred to in these columns in March, and involve chiefly tobacco plants growing elsewhere than on current tobacco crop lands.

The methods which are to be used for the destruction of tobacco plants, including stalks and roots, and of alternate hosts, are, broadly stated, burning, composting, or any other method approved by an inspector.

The above are further examples of farm cleanliness enforced by law. "Cleanliness," as has been stated repeatedly, "Aids Insect Control."

Silage.

One of the most extraordinary developments in British agriculture is the tremendous increase in the making of silage brought about by the war. The supply of imported feeding stuffs has been progressively decreased, but grass silage has so far managed to provide winter feeding. Grass cut young is exceedingly nutritious: at Home now it is cut when 6 to 10 inches long for silage. It is packed into the silos and sprayed with molasses and water. All sorts of makeshifts have been tried for the manufacture of silos, in view of the shortage of timber, and many of them are surprisingly efficient. Grass silage in 1939 was experimental: now it is firmly established and in a year and a half the amount of grass cut for silage has increased over twelve-fold.

The land is worthy of the best brains we have and we must fashion an agricultural system that will attract them.—*The Rt. Hon. Lord Addison, P.C.*

Veterinary Notes.

ARSENICAL POISONING.

By E. P. Hodgson, Cattle Inspector.

It is surprising that one of the commonest causes of deaths amongst cattle, if not the commonest, receives little attention and respect. I refer to arsenical poisoning. Recent figures for one district showed that during 1940 as many cattle died from arsenical poisoning as from all other known causes put together. The realisation of its seriousness has induced me to write this article describing the careless methods occasionally used in handling arsenical preparations. I make no attempt to discuss technicalities, as I am neither a veterinarian nor a toxicologist. This article is written on practical knowledge obtained whilst carrying out my duties as a cattle inspector, and may be helpful to the stockowner. I am indebted to the District Veterinary Surgeon, Salisbury, for his advice and assistance which have enabled me to submit my views.

When an animal dies from arsenical poisoning, arsenious oxide is usually the cause. So let us first find the source of the cause. The common form in which arsenic is to be found on the farm, and the one which I shall deal with in this article, is cattle dip. Other things containing arsenic are: weed killers, disinfectants, locust poisons, and many other insecticides.

The common cattle dip contains 64% arsenious oxide, and a lethal dose of arsenic is 1 dram, therefore about half a tablespoon of cattle dip is enough to cause the death of any grown animal. The usual way that cattle have access to the poison is where neat dip has been spilt on the ground, either accidentally or possibly deliberately, and is subsequently licked up. Neat cattle dip has a salty taste, and when dried on the ground is soon found by the cattle, who lick it up

sand and all. In nearly all cases when holding *post-mortems* on cattle that have died from arsenical poisoning, sand, soil or gravel, besides inflammation, has been found in the fourth stomach. This leads to the discovery of a place on the farm where the cattle have found access to spilt dip, and have licked it up with the soil. Analysis of a sample of this sand or soil usually shows arsenic present in large quantities. A case came to my notice where some dip drums were required as buckets and were given to a boy to wash out. This was done and the contents carelessly thrown out on the ground where the water evaporated and the arsenic remained until two unsuspecting cows discovered the salty taste. I know of two or three cases where natives have stolen dip drums and emptied the remaining contents on to the ground. In one of these cases thirteen cattle died from licking up the salty dip. I was once called out to a farm to hold a *post-mortem* on a cow, the sixth to have died in four days. *Post-mortem* appearance showed arsenical poisoning and as usual sand was found in the fourth stomach. The herd boy was questioned and fortunately he remembered having seen some cattle licking the ground at a certain spot at the roadside. He showed me the spot and I found two holes had been made in the ground as deep as pudding basins where the cattle had been licking. The sand corresponded with that found in the stomach of the cow. A sample of the sand was taken where the cattle had been licking, and a solution was made which, when tested in my dip tester, showed a very high arsenic content. It was subsequently found that the boy who was sent to the dipping tank with a gallon of dip the previous week dropped it on the way and did not report the matter. Another incident cost the life of a valuable bull. A leaking dip drum was stored on an old sack in the store room, and when the dip in the drum was finished the sack was thrown away. When the bull died bits of sacking were found in his stomach.

Other ways in which cattle have access to arsenic are at the dipping tank. Cattle as a rule do not drink the dirty fluid in the tank, but if driven a considerable distance to the dip without first having a drink and arriving at the tank hot and thirsty, they will drink anything, even the dirty dip. About five pints of dipping fluid that is up to strength con-

stitutes a fatal dose. After a number of years the constant splashing of the dip over the walls and on to the ground near the tank causes an accumulation of arsenic. The water evaporates and the salty dip remains to poison some cattle where the dipping tank is not adequately fenced. When a dip is emptied to clean out the silt at the bottom of the tank, the fluid is nearly always emptied into a hole dug for the purpose, and if not properly fenced and protected with storm drains this is a source of danger. On the other hand, an animal will not die from licking its body after dipping because sufficient dip cannot be consumed in this manner.

In cases where cattle have died from arsenical poisoning an attempt is made to trace the source of the poison, even so far as to suspect a boy, who has recently come in for a little farm justice, of taking vengeance by deliberately administering the poison. It is best therefore to exercise precaution with the original source by keeping all dips, insecticides, etc., under lock and key and allow no irresponsible native to handle them.

Most deaths from arsenical poisoning occur within a few hours of the poison being taken, giving the owner very little time to notice that an animal might have been ailing. This gives him no chance to give an antidote, besides, unless he actually sees the animal take the poison he will not have known, until he has held a *post-mortem* and found the cause of death, that an antidote was required. When it is established that the cause of death is arsenical poisoning, precautions can be taken to prevent any subsequent deaths by dosing any animal apparently off-colour with an antidote until the source of the poison has been found and rendered inaccessible to stock. Antidotes do not harm if they are administered to cattle not suffering from poisoning. One of the simplest and cheapest antidotes for arsenic is hyposulphite of soda (ordinary photographic hypo), the average dose of which is 1 oz. in half a bottle of warm water, repeated later if necessary. Should arsenical poisoning be suspected, and confirmation is sought, a sample of the contents as well as a portion of the wall of the fourth stomach, and a portion of the kidney should be taken and sent in an air-tight jar or tin to the Chief Chemist with a request that it be tested for arsenic.

(The fourth stomach is the small one lying between the big bag and the small intestine, with the lining of loose folds.)

Cattle dip is also responsible for another farm tragedy often causing the deaths of cattle. This is dip scalding. Dip scald occurs when an animal's skin is subjected to an application of arsenic more than it can safely absorb. The hair comes off and the skin presents a burnt appearance. If the scald is extensive the animal will die. It is caused, generally, through dipping cattle in dip that is considerably over-strength, dipping cattle after driving them a long way in the heat, and dipping cattle unused to regular dipping. Cattle dip must be treated with the greatest respect. Though extensive experiments have been made to arrive at the most effective strength of dip—strong enough to kill ticks, and not strong enough to scald the cattle—very little margin for error has been lef either way. One often hears farmers state how thorough they are with regard to regular weekly dipping. They will assure you that they dip religiously for the good of their cattle and not because a law compels them, yet when their dips are tested one sees how careless some of them are about the strength. Some will be dipping in almost water, while others are nearly killing their cattle in double strength dip. There is too much guess work in keeping the dip at the correct strength. I cannot over-emphasise the damage and loss that is incurred, and I have seen it, caused by this negligence. Many farmers do not possess a dip tester. I know even prominent farmers who have several hundred head of cattle still depending on the "guess system" for maintaining the correct strength of their dips. It usually happens that gallons of dip are wasted by their dips being unnecessarily over-strength, or there is loss among cattle from tick-borne diseases by their dips being under-strength. The small outlay for the cost of a dip tester would save pounds. The test is a simple one lucidly described in the instructions included with the outfit.

Cattle dip is a deadly poison and is, unfortunately, a necessary evil, therefore the greatest care should be exercised in handling it. It my travels as Cattle Inspector I have seen and been appalled by the carelessness with which so dangerous a thing as cattle dip is treated. I have seen

instances, scores of instances, where money and cattle could have been saved if the respect and care that is due to cattle dip were exercised.

I therefore summarise as follows:—

1. Keep all dip locked up.

2. Allow only one responsible person to handle the dip, and all receptacles used in connection with the dip, and the empty dip drums.

3. Roof and fence off the dipping tank, and protect it with storm drains.

4. Keep all dip kraal gates closed when not in use.

5. Obtain a dip tester and maintain the correct strength of the dip.

6. Atttend to all dipping operations personally to see that no thirsty cattle enter the dip.

7. Keep a supply of hyposulphite of soda on the farm.

If every farmer were to do this then only would the damage and loss caused by cattle dip be reduced to a minimum.

Sunnhemp (Crotalaria Juncea): Not Poisonous to Pigs.

By D. A. LAWRENCE, Veterinary Research Department, Salisbury.

During the past year reports were received that many deaths amongst pigs had been caused by the feeding, either intentionally or accidentally, of sunnhemp.

In one case sunnhemp hay was used as bedding and deaths were attributed to the pigs eating it, the owner's suspicion being that the seeds in particular were poisonous.

In another case it was reported that heavy mortality followed the feeding of sunnhemp seeds which had been cooked by a native in mistake for beans.

Experiments were therefore undertaken to determine whether sunnhemp was in fact poisonous to pigs and, if so, in what stage.

Sunnhemp Hay.—At the time of the experiments no sunnhemp hay was available, but a report was kindly furnished by the Chief Animal Husbandry Officer that sunnhemp hay had been successfully fed to pigs at the Rhodes Matopos Estate. This feeding test had been undertaken there not with the object of determining whether it was safe to feed sunnhemp, but to ascertain the relative feeding values of sunnhemp hay and other legume hays. The feeding test was continued until the pigs were sent to the bacon factory and, apart from supplying the information sought concerning its nutritive value, proved that sunnhemp hay was not poisonous to pigs. Subsequently a report was received from a farmer that he had fed sunnhemp hay to his pigs with good results and no adverse effects. It was therefore considered unnecessary to test the plant further in this form.

Sunnhemp Seed.—It was considered most unlikely that sunnhemp seed would be fed to pigs, except accidently, but it was nevertheless considered necessary to test its toxicity

owing to the possibility that some hay samples might contain far more seed than those known to have been fed successfully, and thus cause deaths if the seeds were poisonous.

Pig No. 1 received $\frac{1}{2}$ lb. boiled sunnhemp seed daily from 18th to 25th February, *i.e.*, 4 lbs. in all.

Pig No. 2 received 1 lb. of sunnhemp seed, ground into meal, on 25th February and another 1 lb. on 27th February.

Pig No. 3 received 1 lb. of sunnhemp seed meal and 1 lb. of boiled seed on the 21st March.

All the above pigs remained healthy, thus proving that sunnhemp seed is not toxic to pigs, either in the raw or in the cooked state and irrespective of whether it be given in large quantities once or twice or in smaller quantities daily over a period. Even the smaller quantities of seeds ($\frac{1}{2}$ lb. per day) were greatly in excess of anything which would normally be obtained by a single pig from any sunnhemp hay.

Green Sunnhemp.—Although it was realised that sunnhemp was never likely to be fed as a succulent, *i.e.*, in the young green state, a toxicity test of the plant in this stage was also made. Pig No. 2 was given 5 lbs. 14 ozs. of young green sunnhemp, all other green food being withheld. Not more than half of this supply was eaten over a period of four days. When the material was first given the pig approached it readily and, after sniffing round, started to nibble at the young shoots but soon ejected them in a half chewed state. Thereafter periodically it would chew an odd shoot, but obviously found it most unappetising. This pig remained healthy.

From this it is apparent that, quite irrespective of whether or not green sunnhemp is toxic, to feed it to pigs is impracticable, as they will not eat it readily if at all. In this connection it should be mentioned that some difficulty was also experienced in getting the pigs to consume the seeds either when boiled or when ground into meal.

Conclusion.—Sunnhemp (*C. juncea*) is not poisonous to pigs in the form of legume hay, nor are its seeds toxic either when boiled or in the form of meal, and in the young green state it is not palatable to pigs.

Agricultural Experiment Station, Salisbury

ANNUAL REPORT OF EXPERIMENTS, SEASON 1939-40.

By H. C. Arnold, Manager.

The season, as a whole, was a very favourable one for most of our crops. Copious rains during the seeding period ensured good stands, and later, alternating periods of sunshine and rain with fairly high temperatures produced favourable conditions for plant growth and heavy yields resulted.

Analysis of Rainfall, Season 1939-40.

Month.	No. of rain days.	Total for the month.	No. of rains over ¼ inch.	Total to end of month.	Periods exceeding one week without rain.
October	4	2.06	2	2.06	Oct. 28th to Nov. 4th.
November ...	12	5.07	6	7.13	Nov. 19th to Nov. 26th
December ...	23	10.34	12	17.47	Nil.
January	14	5.50	2	22.97	Nil.
February... ...	20	7.65	9	30.62	Feb. 16th to Feb. 23rd
March...	15	4.75	7	35.37	Mar. 25th to April 3rd
April	7	2.60	3	37.97	
Totals...	95	37.97	41		
Average for the previous 10 years ...	76	34.7	37.5		

This tabulation shows that from the commencement of the rains until their termination in April no seriously droughty period occurred.

The results of experiments conducted at this Station since the year 1919 are available in Bulletin form, and to facilitate comparison, this report is drawn up on lines similar to previous ones.

The maintenance of the humus content of the soil is of the utmost importance and the majority of our farmers make a practice of ploughing under a crop of sunnhemp or other leguminous crop every few years. Although the efficacy of the green manurial treatment is thus acknowledged by all, there is still much difference of opinion as to the number of marketable crops which may profitably be grown between applications of green manure. Experience has proved that even when the top growth of the leguminous crop is not ploughed under, but is utilised instead in the form of hay, or is allowed to reach maturity for the purpose of producing seed, there is still a marked improvement in the growth of the cereal crop which follows. The question arises, therefore, as to whether those farmers who are able to utilise the legume crop as cattle feed might not find it advantageous to make use of it in that way rather than to plough the whole crop under. With the object of securing information on these questions, trials were commenced during the season under review, in which the effect on the maize crops which follow ploughing under a sunnhemp crop every second, third, fourth and fifth year will be compared with haying the legume crop or allowing it to mature for seed at similar periods. This experiment also includes plots on which the effect of temporary pasture will be compared with that of green manuring in the restoration of the humus content of the soil. The scheme consists of fourteen distinct methods of treatment and from eight to ten plots are allotted to each treatment.

CROP ROTATION EXPERIMENTS.
FIRST SERIES 1913-1940.

Maize Yields in Bags per Acre.

System of Cropping.	1939-40 Rainfall 37.97	1938-39 Rainfall 51.33	1937-38 Rainfall 29.47	1936-37 Rainfall 32.68	1935-36 Rainfall 24.01	1934-35 Rainfall 31.07	1933 34 Rainfall 31.54	Average Yield.
*A1—Maize continuous. Green manure and 250 lbs. per acre of phosphatic fertiliser in the seasons 1928-29, 1932-33 & 1935-36	17.70	Green Manure ploughed under.	10.53	16.10	Green Manure ploughed under.	4.99	19.04	13.31 (8 crops)
*A2—Maize continuous. Fertiliser only, rates as above.	9.5	2.33	5.49	9.10	6.12	2.01	8 74	6.53 (12 crops)
†B—Alternate maize and beans for hay; no manure or fertiliser.	8.22	2 70	8.36	5.60	11.70	4.45	6.60	8.83 (25 years)
C — Three-course rotation: Maize, velvet beans (reaped), oats; no manure or fertiliser.	10.79	8.07	9.83	5.80	13.25	5.82	10 75	12.67 (25 years)
D—Four - course rotation: Maize (plus 6 tons dung per acre), oats, bean hay, maize. Average of two plots.	13.46	5.74	11.69	14.30	14.82	6.81	14.70	
Maize (no manure direct).	14.45	6.19	9.78	14.70	16.63	6.82	11.90	16.01 (24 years)
Maize (dunged plots).	12.48	5.28	13.60	13.90	13.00	6.80	17.50	15.71

*NOTE.—Having grown maize for 15 years in succession without manure or fertiliser, during which time its yields had gradually decreased until they had become so low as under practical field conditions to have rendered them negligible, this plot had served its purpose. With the object of comparing two methods of again raising the cropping power of such land to a more profitable standard, the whole plot was treated with a mixture of one-third bone meal and two-thirds superphosphate at the rate of 250 lbs. per acre at the beginning of 1928-29. One-half of the plot was sown to a mixture of sunnhemp and velvet beans, which were subsequently ploughed in. This manurial treatment was repeated on the respective plots during the seasons 1932-33, 1935-36 and 1938-39.

†In 1929-30 this system was amended from "Alternate Maize and Bare Summer Fallow" to "Alternate Maize and Beans for hay."

System A.—This trial affords striking proof of the effectiveness of green-manuring combined with a moderate application of phosphatic fertiliser, and also that dressings of phosphate alone would be less profitable than when they are combined with an adequate supply of humus. On the green-manured section the yield this season is as much as the total for three seasons on the adjoining land where no humus dressing is given. The total yield obtained from the combined treatment section since this system was commenced in the season 1928-29 exceeds that of the phosphate-only plot by twenty-eight bags per acre. During this twelve-year period the average yield of the eight maize crops reaped in the green-manured system is twice as large as the average yield from the other system.

System B.—To some extent the favourable seasonal conditions account for the comparatively high yield from this section; but the system of cropping which provides for the ploughing under of the roots of the leguminous hay crop provides a certain amount of humus for the cereal crop which follows. The plot from which 8.22 bags per acre were reaped this season yielded 8.36 bags and 11.70 bags in the years 1938 and 1936 respectively. These gradually diminishing yields indicate a corresponding decrease in the amount of available plant food. The results obtained in other experiments indicate that phosphate is chiefly required. The addition of humus alone, though of considerable assistance, is not sufficient to maintain the cropping power of this land at its original level.

System C.—In this rotation also a gradual reduction in the ability of the land to produce maize has taken place, but by growing two other crops between each maize crop instead of only one, as in System B., the depletion of the soil fertility here has proceeded at a lower rate than in the other system. The average yield for the seventeen year period 1914-1932 was 14 bags per acre; that for the four-year period 1933-36, 8.68 bags, and for the following four year period 1937-40, 8.62 bags. Hence the rate of depletion appears to have slowed down very considerably during the past few years.

System D.—The yields in this system are fairly high again as a result of the favourable seasonal conditions coupled with

the rotational and manurial treatments. This system simulates mixed farming conditions more closely than the others, because the side crops it includes would be fed to farm stock, and farmyard manure would be available for application to the land for the restoration of the humus it requires. In spite of this, however, comparison of these yields with those shown in System F. hereunder indicates that applications of phosphate would increase the yields of maize.

SECOND SERIES OF CROP ROTATIONS.

These rotations were laid down in 1919-20 and were designed to evolve a system of cropping which would meet the needs of farmers who could not adopt a system of mixed farming. The series includes two plots, A. and F., on which maize has been grown continuously, excepting that last season on one half of plot A. a green manure crop was grown, the top growth of which was composted and returned to the same plot in order to ascertain the effect of a humus dressing on land which has been continuously cropped to maize for twenty years. No artificial fertiliser has been applied to plot A. at any time. On plot F., commencing season 1929-30, phosphate fertiliser is applied in alternate years. The fertiliser treatment given to this plot is the same in quantity and quality as that accorded in rotational system H., but humus dressings, either in the form of green-manuring, compost or farmyard manure, are entirely omitted.

System E., Plot A.—Maize continuously for twenty years. Commencing season 1939-40, on one half (A.1.) green-manure crops were grown, the top growth of which was composted and returned again to the same plot. During the season under review maize was grown on both of the sub plots, which are now designated A.1. and A.2.

Seasons and Yields of Maize in Bags (200 lbs.) per Acre.

	1939-40	1938-39	1937-38	1936-37	1935-36	1934-35	Average 21 years.
A.1.	12.10	—	—	—	—	—	—
A.2.	7.33	3.63	3.89	3.80	6.88	2.21	8.68

The addition of the humus dressing has increased the maize yield of this land by nearly 5 bags per acre. The yield

on the composted sub-plot is heavier than any recorded for this land since the season 1921-22, while that on the unmanured plot has not been exceeded since the year 1931-32 when 11.6 bags per acre were reaped. The low yields (average 4.8 bags per acre) obtained in this system for the past ten years would return but a very small margin of profit (if any).

System F., Plots B. to E.—Three-quarters of the land under maize, one quarter under Sudan grass. Each year one section under maize commencing with Plot B. in 1919-20, receives eight tons of farm manure per acre, and commencing on Plot E in 1929-30, the section which grew Sudan grass the previous season receives 200 lbs. per acre of superphosphate (19 per cent. P_2O_5).

Maize Yields in Bags of 200 lbs. per Acre.

	1939-40	1938-39	1937-38	1936-37	1935-36	1919-20	Average 1920-40
Plot B	17.15*	6.45†	Sudan	11.50	19.55*	26.0	16.13
Plot C	13.83†	Sudan	11.74	14.75*	15.93†	23 7	15.02
Plot D	Sudan	7 25	12 64*	15.25†	Sudan	Sudan	14.96
Plot E	16.99	9 45*	10.69†	Sudan	16.68	24.6	15.31
Average	15.99	7.81	11.69	13.83	17.39	24 7	15.36

*Indicates the application of farmyard manure.

†Indicates the application of 200 lbs. per acre superphosphate.

The influence of the favourable climatic conditions are clearly shown this season, as the yields are the highest recorded since the year 1936. The plot which receives the dressing of humus almost invariably produces the highest yield. During the past three seasons the crop which follows the one which receives the manure has also been heavier than the one which receives the dressing of phosphate. This seems to indicate that the humus dressing is the limiting factor, though it may also be attributable to the demands the preceding Sudan grass crop makes on the available fertility, combined with the depressing effect of the extensive root system of that crop which is in the soil in an unrotted state in the season in which the phosphate is applied to the maize crop which follows the Sudan grass.

System G., Plot F.—Maize continuous. No manure or fertiliser during the first ten years. Commencing season

1929-30 fertiliser similar in kind and in quantity to that provided in System H. has been applied to this plot.

Seasons and Yield of Maize in Bags per Acre.

1939-40	1938-39	1937-38	1936-37	1935-36	1934-35	1919-20	Average over 21 years.
11.40*	3.93	7.79*	6.65	16.26*	3.70	23.3	10.76

*Indicates the application of 200 lbs. per acre fertiliser.

The applications of phosphate on this plot have frequently synchronised with favourable weather conditions, and this, in part, accounts for the high yields obtained in those seasons. Comparison with the yields obtained in the other systems shows that heavier yields are obtained in those which receive a dressing of humus in addition to the phosphate.

System H., Plots G. to K.—Three-quarters of the land under maize, one-quarter under velvet beans, which are ploughed under for green manure. From the commencement of this experiment until 1928-29 this land received one green manuring and one application of fertiliser during each period of four years. The returns from these plots showed that insufficient plant food had been supplied to maintain fertility, and the manurial system was then amended to provide for two dressings of fertiliser during each four-year period. The crop of maize which follows the green manuring now receives 200 lbs. of 19 per cent. superphosphate per acre, which should enable it to make the best use of the nitrogen supplied by the green manure; the second maize crop receives no fertiliser, and the third crop, that immediately in front of the green crop, receives 200 lbs. per acre of raw rock phosphate.

Maize Yields in Bags per Acre.

	1939-40	1938-39	1937-38	1936-37	1935-36	1919-20	Average 1920-40
Plot G ..	10.52	14.23*	Beans	11.20*	14.78	23.10*	14.24
Plot H .	21.35*	Beans	8.40*	9.90	20.28*	23.00	15.39
Plot J	Beans	3.79*	9.86	20.56*	Beans	Beans	13.07
Plot K	12.58*	4.58	18.18*	Beans	15.35*	19.20	13.82
Average	14.82	7.53	12.15	13.89	16.80	21.70	14.13

*Denotes application of fertiliser.

The amount of phosphatic fertiliser applied to the land in this system is the same as that applied in System F. and so the heavier yields obtained here may be attributed to the addition of humus derived from the velvet bean crop which is ploughed in every fourth year.

The question arises as to whether for practical purposes the relative merits of Systems G. and H. might not be more accurately compared by dividing the total yield in System H. by four, because four plots are involved, and each 100 acres under System G. would return 1,140 bags of maize against 1,111 for System H. It may be pointed out that, apart from it being less costly to grow and plough under a green manure crop than it is to produce a crop of maize on a similar area, the yields obtained in previous seasons must also be taken into consideration. If this is done it will be seen that green-manuring has a stabilising effect on the yields, so that when unfavourable weather conditions prevail their adverse influence is considerably less on the green-manured land than on that which receives no humus dressing. In the tabulation below the hypothetical number of bags of maize which would be produced on each 100 acres under cultivation in the two system, G. and H., are shown.

Seasons and Maize Yields in Bags per One Hundred Acres.

	1939-40	1938-39	1937-38	1936-37	1935-36	Average 5 years.
System G.	1,140	393	779	665	1,526	901
System H.	1,111	565	911	1,042	1,260	1,222

It will be generally agreed that systems which tend to equalise the amount of maize produced each and every year are preferable to those which cause bumper crops in favourable seasons and barely sufficient when the weather is unpropitious.

The tabulation shows that in System G. the lowest yield is approximately only one quarter of the highest, but in System H. the lowest yield is almost one half of that obtained in the most favourable season. Over the five year period the green-manured land has produced 35% more maize than the adjoining land which receives the same amount of phosphate but no dressing of humus of any kind.

THIRD SERIES OF CROP ROTATIONS.

In the season 1926-27 two more rotational systems were laid down, which have been designated Systems M. and O. respectively.

System M.—This is a four-course rotation in which the sequence of the crops is:—Maize + 200 lbs. per acre of superphosphate; ground nuts and sunflowers; maixe + 200 lbs. per acre of raw rock phosphate; green manure. Hence one-half of the land is sown to maize, one-eighth to sunflowers and another eighth to ground nuts, and one-quarter is green-manured. In the following tabulation the yields of the various plots are expressed in bags per acre, a "bag" of maize being 200 lbs., and a "bag" of ground nuts 65 lbs.

	1939-40	1938-39	1937-38	1936-37	1935-36	1926-27	Average maize yield 1926-40
Plot A ...	20.13*	G.M.	9.66*	N14.3	14.90*	G.M.	13.63
Plot B	G.M.	6.75*	N17.9	15.72*	G M.	15.15*	11.01
Plot C	14.60*	N8.0	11.48*	G.M.	12.50*	N21.0	13.32
Plot D	16.3	9.54*	G.M.	14.88*	N15.70	12.06	11.43
Average maize yield	17.37	8.15	10.57	15.30	13.70	13.88	12.35

*Denotes the application of fertiliser.
G.M.—Denotes the application of green manure.
N.—Denotes the position of the ground nuts in the rotation.

The manurial treatment given in this rotation is the same as that accorded in System H. The difference is in the method of cropping.

The average maize yields in the two systems M. and H. are about equal to one another, for during the six years just ended the total for M. is 71.84 while the total for H. is 72.69, so there is less than one bag difference in six years. Comparison of the figures will show, however, that in this system there is less fluctuation between the yields of the various plots. For instance, the lowest yield recorded in System M. is 6¾ bags while 3¾ bags is the lowest in System H.; also, in the latter system, the highest yield has exceeded 20 bags three times during the past five years, but only once has that amount been reaped in System M. during the same period. It appears, therefore, that the inclusion of other crops in the

rotation has had a stabilising effect on the yields of maize, even though, so far there is no evidence that yields of maize can be appreciably increased by this means.

System O.—The order of rotation is:—Maize fertilised with 200 lbs. per acre of raw rock phosphate; sweet potatoes; maize which receives a dressing of 8 tons per acre of farmyard manure; hay crops. This system is typical of a rotation suitable for dairymen or others who prefer to feed a large proportion of their crops to livestock. In practice it would probably be found necessary to make alterations to meet individual requirements, such as altering the proportion of maize to other crops; leaving the sweet potatoes down for two years, or reducing the amount of land under sweet potatoes and growing pumpkins and melons instead. Whatever the details of the adopted system may be, if the principles on which this rotation is based are adhered to, similar results could be expected.

In the tabulation below are shown the acre-yields of maize in bags of 200 lbs. and of bean hay and sweet potatoes in tons.

Seasons and Yields in Bags (or Tons) per Acre.

	1939-40	1938-39	1937-38	1936-37	1935-36	1926-27	Average maize yield 1926-40
Plot F ...	15.69*	H 1.20	12.03†	P 1.02	19.32*	H 1.1	16.69
Plot G ...	H 2.34	7.54†	P 1.25	15.61*	H 1.4	19.65	14.08
Plot H ...	17.95†	P 2.7	11.73*	H 2.29	17.78†	P 6.1	17.26
Plot J ...	P 13.9	12.53*	H 1.32	14.85†	P 3.70	16.45*	12.53
Average of maize plots	16.82	10.04	11.88	15.23	18.55	18.05	15.39

*Denotes the application of fertiliser.
†Denotes the application of farmyard manure.
P.—Denotes the position of the sweet potatoes in the rotation.
H.—Denotes the position of the bean hay crop.

In the season 1938-39 the plot which received the farmyard manure gave a much lower yield than the one to which the phosphate was applied, presumably because the excessive rains prevented normal action by the soil micro-organisms which convert that form of manure into plant foods. The weight of the bean hay crop grown on that land this year indicates that this crop benefitted more than the maize crop to which the manure was actually applied. The heavy yield

of sweet potatoes is due in part to the favourable weather conditions, but it may also be attributed to the change to the "Virovsky" variety. In previous seasons "Early Butter" has been planted, and although that kind has yielded as high as ten tons per acre in other trials some years ago, its yields on these plots have been very disappointing during the past few years.

Methods of Utilising the Sunnhemp Crop for the Restoration of Soil Fertility.— These trials were commenced in the season 1935-36, when sunnhemp was sown and treated in different ways. The plots were all sown to maize in the season 1936-37 and the results were published in the *Agricultural Journal* for September, 1938. Slight amendments were made in the plan of treatments and sunnhemp was again sown in the season 1937-38 and treated in the following ways:—

(*a*) Sunnhemp for green manure ploughed under in the usual way eighteen weeks after the germination of the seed.

(*b*) Top growth of sunnhemp crop cut off eighteen weeks after germination, composted and returned again to the same plots.

(*c*) Top growth of sunnhemp cut for hay. Stubble only, ploughed under during the autumn months.

(*d*) Top growth of sunnhemp cut off, composted and applied to the (*e*) plots, which carry maize instead of the green manure crop. Stubble only of 18 weeks old crop ploughed under.

(*e*) Maize continuously; land receives application of compost made from the top growth of the green manure crop on the (*d*) plots.

(*f*) Maize continuously without humus dressing.

The above treatments were replicated 10 times and each of the sixty plots in the experiment was divided into two; on one sub-plot of each pair phosphatic fertiliser at the rate of 200 lbs. per acre was applied. The fertiliser consisted of a mixture of equal quantities of raw rock phosphate and superphosphate. Maize was sown over all of these plots last season and also during the season under review. The results for these three seasons are shown in the following tabulation.

Yields of Maize in Bags per Acre.

P=200 lbs. per acre phosphatic fertiliser.
O=No artificial fertiliser.

	(a) Sunnhemp P. under.		(b) Sunnhemp composted.		(c) Sunnhemp hayed.		(d) Sunnhemp stubble only p.u.		(e) Maize continuously, compost only.		(f) Control. Maize continuously (no humus).	
Seasons.	P	O	P	O	P	O	P	O	P	O	P	O
1937-38	Sunnhemp		Sunnhemp		Sunnhemp		Sunnhemp		4.2	4.2	2.7	2.7
1938-39	17.2	16.7	14.0	13.0	10.6	10.1	11.5	11.3	4.3	4.0	2.8	2.7
1939-40 ...	15.1	13.3	16.3	14.9	10 9	9 8	11.9	10.8	14.3	12.5	9.4	8.7
Two seasons	32.3	30.0	30.3	27 9	21.5	19.9	23.4	22.1	22.8	20.7	14.9	14.1
Total bags per acre (average)	31.15		29.1		20.7		22.8		21 8		14.5	
Increase due to P.	2.3		2.4		1.6		1.3		2.1		0.8	
Increase due to humus application	16.65		14.6		6.2		8.23		7.3			

These returns show that the maize crop was proportionate to the amount of humus applied to the land. Where the whole crop was ploughed under, either in the form of green manure or when the top growth was made into compost and returned to the land again, the increase of crop was approximately twice as much as it was on that land to which the roots only were returned. The land which received the other half of the sunnhemp crop after it had been composted also shows an increase over the control treatment which is about one half as large as that produced where the whole crop was turned in.

Comparison of the increases due to the application of 200 lbs. per acre of phosphatic fertiliser with those due to the application of humus show the differences to be very marked, the humus dressings having given increases approximately six times as large as those obtained from the phosphate.

The increases due to the phosphate were also dependent on the amount of humus applied to the land. The increase was approximately three times as great where the whole sunnhemp crop was returned to the land as it was where the twice as great where the sunnhemp roots only were ploughed under.

In regard to the respective merits of the (*a*) and (*b*) methods of utilising the sunnhemp crop, it may be pointed out that during the season 1938-39 the rainfall was unusually large and the temperatures low, so it is possible that where they were ploughed under whole; the gradual shrinkage of the decaying sunnhemp stalks helped to aerate the soil so that the excess of moisture drained away more rapidly and the ingress of air for the use of the soil micro-organisms was facilitated. In a "dry" season excessive aeration from this cause might have the opposite effect. In the second season the (*b*) plots recovered somewhat so that the total yields for the two seasons show a smaller difference than the yields for the first season.

Where the sunnhemp crop was used as hay the top growth was cut when it was eleven weeks old. Previous experiments have shown that even when the whole sunnhemp crop is ploughed under, if it is not sufficiently mature, the benefit it confers on the soil is much reduced. It is not surprising therefore that the yield of maize following the haying of the immature sunnhemp crop is lower than that following the other treatments. In practice the sunnhemp hay would be fed to farm animals and hence a large proportion of the crop could be returned to the soil again in the form of farmyard manure. Thus the ultimate return might be as large as that obtained from the other methods. In the (*d*) method the sunnhemp was not cut until it was 18 weeks old, and the effect of the more mature growth is shown in heavier yields of maize than were obtained where the crop was cut at the hay stage. Reference to the yields of the (*e*) plots which received the compost made from the top growth of sunnhemp grown on the (*d*) plots, shows that the compost had little effect during the first season. This was probably due to the heavy and continuous rains experienced that season, but it roots of the maize crop were the sole source of humus, and also suggests that the compost may not have been sufficiently rotted when it was applied. Consequently, owing to the wet and cold condition of the soil the plant nutrients in the compost remained locked up until the present season, during which further disintegration took place, the plant nutrients were released and the yield of maize obtained was nearly as large as that on the plots on which the whole of the sunnhemp was returned to the land in the form of green manure.

The Protein production of various Fodder Crops.—These trials were commenced in the season 1935-36 for the purpose of ascertaining which of the numerous fodder crops available for cultivation in this Colony would yield the largest amount of protein per acre. It is well known that the protein is an essential nutrient required by all farm stock and that such easily grown foods as grass, maize and similar crops do not contain sufficient protein to "balance" their carbohydrate and fibre content. For this reason stock feeders who grow cereal crops only, are obliged to purchase protein or to feed unbalanced and uneconomical rations. Purchased proteins are usually, either unpalatable, expensive or obtainable in limited quantities only, and so the stock-feeder, who does not provide sufficient protein for his animals by growing suitable crops on his farm, is likely to find himself handicapped by having to feed either unbalanced or expensive rations during the winter months. During the past year or two, mixtures consisting of two crops have been included, but it has been found that the difficulty of obtaining reliable data has been much increased when two crops are grown together. Although precautions were taken at sowing time to sow equal proportions of each crop, at reaping time it was almost invariably found that either one or other of the pair had been retarded through adverse climatic conditions or insect attack, so that, when the crop was reaped, the fodder mixture contained much less of one kind that it would have done if conditions equally favourable to both crops had prevailed throughout the season.

It will be realised, therefore, that the yields of protein recorded below for mixed crops may vary widely from those which would be obtained under different conditions.

Yields of Protein in Lbs. per Acre.

	Velvet beans as hay.	Velvet beans as silage.	Velvet beans and sunflower.	Biltan soya beans	Sunnhemp 11 weeks.	Sunnhemp 14 weeks.	Maize silage.	Maize mature crop.	Wintersome.	Wintersome and dolichos biflorus.	S.E.S. oats and dolichos biflorus.
1935-36	869	..	...	419	435	...	296	...	364	...	...
1936-37	468	...	. .	311	270	...	177	...	249	...	...
1937-38	820	805	..	594	256	248	312	377	248	...	...
1938-39	363	537	1,018	620	244	354	495	408	539	...	. .
1939-40	946	735	542	586	451	. .	376	522	401	484	462
Averages ...	693	692	780	506	331	301	331	436	360	...	...

These returns show that the velvet beans have consistently yielded larger amounts of protein per acre than any of the other crops. In the past considerable trouble was experienced in curing the fodder for hay through the large size and fleshy nature of the seed pods, which required from four to six weeks to cure. This difficulty has, to some extent, been overcome by the introduction of the late-maturing varieties Marbilee and Jubilack. These produce a larger proportion of vine growth than the older varieties, so that if their fodder is reaped before the seed pods are fully developed only a small proportion of the crop will be sacrificed. When the velvet bean crop is utilised as silage it can remain in the field for a longer period if desired, because the fleshiness of the pods does not interfere with the curing of the material in the silo. When velvet bean fodder is ensiled alone, the product is usually not very palatable to farm stock, and it is advisable to mix two per cent. of molasses or twenty per cent. of wintersome fodder with the material when it is put into the silo. If this precaution is taken a roughage which is both high in protein and palatable to livestock will be obtained. The velvet bean and sunflower silage is also unpalatable, and is much improved by the addition of molasses or wintersome. Maize stalks may also be used if neither wintersome nor molasses is available, but a larger quantity is required to secure the same degree of palatability and the protein percentage in the mixture is lessened in consequence. Soya beans rank next to velvet beans for protein production. Their erect growth facilitates harvesting operations, and they may be used either as hay or as silage. Their fodder contains a higher percentage of protein than that of any of the other crops included in these trials and is palatable to all classes of livestock. The variety called "Biltan" was used in these trials, but this has now been superceded by the "Jubiltan" strains which are less prone to "shatter" their seed, and yield somewhat heavier crops, though they require a longer period in which to complete their growth. Although sunnhemp produces a smaller crop than the other legumes, it has the advantage of quick and erect growth which can be harvested expeditiously and it quickly cures into a palatable hay. During the past year or two its seed has been scarce. Although

this may have been due largely to seasonal conditions, it may show the necessity for seed selection with the object of maintaining the yielding ability at the same level as the original stock. Unless this can be done, and if the downward trend in seed production continues, the seed may become so expensive as to prohibit the use of this crop as hay, or, in fact, for any other purpose. Maize and wintersome both yield large quantities of material which may be easily stored in the form of silage. A very useful and palatable succulent is thus made available for use during the winter months. This fodder is uneconomical however, because, although it contains large quantities of carbohydrates, protein content is very low, and so protein must be obtained from other sources to balance the load of starch, or alternatively, the excess of starch has to be sacrificed. Another factor which should be taken into consideration is the quantities of material which have to be handled. Maize and wintersome yield 15 to 20 tons of green fodder per acre containing 300 to 400 lbs. of protein. The same amount of protein, per acre, or even more, can be obtained from the leguminous crops, and if their fodder is cured into hay, only one-tenth of the weight needs to be hauled from the field to the place where the livestock is fed. In other words, 100 acres under wintersome may yield as much as 2,000 tons of green material, but this will contain less of that essential nutrient, *protein*, than 200 tons of soya bean hay which may be produced on a similar area, and can be hauled and fed at a considerably lower cost.

During the season under review the wintersome crops did not thrive as well as usual owing to stalk-borer attack, and where *Dolichos biflorus* was sown between the rows it made up for the set-back to the wintersome. It is good farming practice to grow two crops together in this way, because if one fails the other may take its place and mitigate the loss.

The scheme will not be successful unless the partners are compatible. Wintersome, *Dolichos biflorus* and velvet beans thrive very well together and make a suitable silage mixture. S.E.S. oats and *Dolichos biflorus* are a compatible pair whose fodder can be cured as hay.

PLACEMENT OF FERTILISER TRIALS.

These trials were commenced in the season 1931-32. The fertiliser is applied in four different ways, namely, (1) broadcast on the surface and harrowed in shortly before the crop is sown; (2) broadcast on the stubble of the previous crop and ploughed in; (3) placed in the holes prepared to receive the seed; (4) placed in drills with the seed to simulate the action of mechanical drills.

Each method of applying the fertiliser is replicated five times. During the seasons 1933-34 and 1936-37 the land was green-manured. In the first four seasons superphosphate at the rate of 150 lbs. per acre was used, but since the land was last green-manured raw rock phosphate has replaced the superphosphate.

The following tabulation shows the mean yields of the five plots under each treatment, expressed in bags per acre. The last column shows the loss due to the incorporation of the fertiliser in the surface layer of the soil expressed as a percentage of the mean of the yields obtained where the other methods of application were employed.

Yields in Bags (200 lbs.) per Acre.

Season.	Fertiliser harrowed in.	Fertiliser ploughed in.	Fertiliser in seed hills 3'x3' apart.	Fertiliser in drills with seed.	Percentage lost due to surface application.
1931-32	16.46	19.72	18.04	18.06	11.55
1932-33	6.02	8.00	6.66	8.30	21.30
1934-35	10.50	11.08	11.30	12.12	8.69
1935-36	16.00	15.18	15.72	15.66	nil
1937-38	13.10	13.78	15.60	15.70	12.84
1938-39	2.66	3.54	3.50	3.58	24.85
1939-40	9.98	12.10	11.54	11.76	15.42
Total of 7 crops	74.72	83.40	82.36	85.18	

These returns show that when the fertiliser is mixed with the surface layers only, the plants are unable to utilise as much of it as they can when it is placed deeper down where the roots are not affected by changes of temperature and moisture to the same extent as those near the surface. The various methods of applying the fertiliser have been employed on the same plots over the whole period, and it is somewhat surprising that the unused residue of the fertiliser added to the "harrowed in" plots has not been more fully utilised by subsequent crops, because although it has been applied to the surface layers, it has become mixed with the whole of the cultivated part of the soil during subsequent tillage operations. The figures in the last column show that the loss is very considerable and is proportionately greater in unfavourable seasons. During the very favourable season of 1935-36 the yield of the "harrowed-in" plots was equal to that of the other plots. The three other placement methods are shown to be equally effective.

RAW ROCK PHOSPHATE. QUANTITATIVE TRIALS FOR MAIZE PRODUCTION.

The object of these trials is to ascertain whether it is possible and economical to increase the yield of maize by increasing the quantity of raw rock phosphate applied to the land. The experiment was commenced in the season 1935-36 on land which had been green-manured in the two previous seasons. Raw rock phosphate is applied to each maize crop at three different rates, namely, 150 lbs., 300 lbs. and 450 lbs. per acre, and each of these dressings is replicated ten times. Two crops of maize were grown and in the third season the whole area was green-manured again. Since then two more crops of maize have been grown, both of which were dressed with raw rock phosphate at the same rates as before. Since the season 1935-36 therefore four dressings of phosphate have been applied which total 600 lbs., 1,200 lbs. and 1,800 lbs. per acre on the respective plots. In the tabulation below the mean yield of the ten plots in each series is shown in bags per acre.

Yields of Maize in Bags (200 lbs.) per Acre.

Season.	150 lbs. per acre Phosphate.	300 lbs per acre Phosphate.	450 lbs. per acre Phosphate.
1935-36......	22.38	24.18	24.80
1936-37.....	12.15	12.81	11.67
1938-39......	19.64	21.75	23.00
1939-40......	11.97	12.38	13.29
	66.14	71.12	72.76

Although slightly heavier yields have been obtained on the land which received the heavy dressings of phosphate, the increases are too small to cover the cost of the extra fertiliser. The reason for so little response to the heavy dressings may be due to the operation of the "law of diminishing returns," or alternatively, it may be due to a deficiency in the supply of potash. In the past, applications of potassic fertilisers at this Station have not increased the yield of maize, but it is probable that sooner or later the reserves of potash in the soil will become depleted, particularly where large crops have been taken off the land in previous years. Commencing next season, each of the plots will be sub-divided and a dressing of potash will be applied to one-half, while the other will receive phosphate only.

Seed Maize Production.—The necessity for using seed with desirable hereditary characteristics is generally acknowledged. In the past the selection for seed purposes of ears of maize which carried a large quantity of sound grain and possessed other visible refinements has been practised. By this method considerable improvement in the quality and size of the ears has been effected, disease resistance has been increased and strains which are more suited to the Colony than any which can be obtained from beyond our boundaries have been built up. Despite these achievements the benefits obtainable by the old methods are limited through innate weaknesses and lack of control over the male parent.

In the United States of America the production of seed maize by mating together inbred strains, known to be capable of transmitting their good qualities to their off-spring, has been proved to yield better results than the field selection

method hitherto practised in this Colony. A very large proportion of the maize grown in the United States during recent years is the product of this so-called "hybrid" seed. With the object of testing this method, under Rhodesian conditions, the "selfing" of individual plants was commenced seven years ago, and we now have several strains which have been inbred for that period. Our stock of selfed strains has been increased during the past four years by the inclusion of new ones derived from superior ears obtained from various growers. They include the Hickory King, Salisbury White and Southern Cross varieties, and have brought our total to over 300 inbred strains. Although there is a very definite uniformity among the plants which comprise each strain, there are very wide and striking differences between the individual strains. During the season under review a number of hybrids obtained by crossing inbreds during the previous season were tested against open-pollinated stock. A large proportion of the hybrids yielded considerably more heavily than the ordinary variety, thus indicating the possibility of future large scale production of seed maize which will be as superior to our ordinary stock, as the hybrid seed has proved to be in America. It is, however, unfortunate that the mere crossing together of inbred strains does not always result in the production of superior progeny. It is necessary to test several crosses and to replicate and repeat them again and again over a period of some few years before absolute certainty of the compatibility of the parent inbreds can be established. Hence this work is being continued with a view to the discovery of suitable inbred strains whose heritable qualities will combine to produce progeny with such desirable characteristics as high yields of grain, resistance to diseases, resistance to adverse climatic conditions and with strong root anchorage which will reduce the loss sustained from wind storms.

Ground Nuts: Size of Seed Trials.—In certain countries it is the practice to sow the large nuts obtained from single-seeded pods in preference to the smaller nuts obtained from pods containing 3 to 5 seeds. On the other hand, other growers consider it preferable to sow nuts from the large pods, because they think that by so doing an increased yield of large pods which have a higher export value will be obtained.

With a view to finding out what influence the size of the seed might have on the resulting crop, experiments were commenced in the season 1937-38. The differences between the seed used were as follows:—

(*a*) Husked seed of large size from pods containing one seed only.

(*b*) Unhusked seed in pods containing one seed only.

(*c*) Unhusked seed in pods containing two seeds.

(*d*) Husked seed from pods containing four seeds each.

In the following tabulation the combined yields of all the replicated plots sown with each kind of seed is given in lbs.

Season.	A Single husked.	B Single unhusked.	C Double unhusked.	D Four-seeded pods: husked.
1937-38	116	149	158	124
1938-39	82	71	66	69
1939-40	78	90	112	93
	276	310	336	286

Statistical analysis of these results show that the yield differences are not significant, but are probably due to causes other than the differences in the size of the seed. There is, therefore, little to be gained in choosing either small pods or large pods, provided that when they are to be planted by machine, the seeds are even in size. Although the yields indicate some slight advantage in using double-seeded, unhusked pods, the extra yield may be due to the better stand resulting from the heavier seeding. When the "foot-rot" disease is prevalent, husked seed which has been treated with a fungicide would probably be found to give a better stand than unhusked seed, because the fungicide would not penetrate through the husks. Hence a proportion of the seed in the infected husks would not germinate and an uneven stand would be the result.

Space between Rows.—In the first two seasons the plots in the trials described above were sub-divided, and on one half the rows were spaced 18 inches apart, while on the other half they were 12 inches apart. The space in the rows was 6 inches

in both cases. In the season 1937-38 the yield from the 12 inch rows was 26 per cent. heavier than that from the 18 inch rows, and in the next season the difference was 18 per cent. in favour of the 12 inch spacing. Although in field practice it might not be advantageous to sow in rows with only one foot space between them, these results show that close spacing conduces to heavier yields. When the rows are two or more feet apart the space between the plants in the rows should not be more than six inches, and even closer spacing might be found advantageous.

Soya Beans.—An article dealing with the cultivation of this crop was published in the October, 1940, issue of this *Journal* and is now available as Bulletin No. 1165. A number of new introductions have recently been made from various sources, and these will be included in next season's trials. So far, however, the most promising strains are those evolved by crossing the Otoxi variety with a yellow-seeded non-shattering type which originated in the Union of South Africa. Further work with these is necessary to ascertain those best suited to various seasonal conditions.

Soya Beans: Distance-planting Trials.—These have been conducted during the past two seasons. In the first season the variety called non-shatter mammoth was used, and in the second season Potchefstroom No. 184. In both trials the distances between rows were 12 inches, 18 inches and 24 inches and the distance between seeds in the row 4 inches. The treatments were replicated six times.

Yields of Seed in Lbs. per Acre.

Season.	Variety.	Rows 12 inches apart.	Rows 18 inches apart.	Rows 24 inches apart.	Increase due to closest spacing.
1938-39	Mammoth	759	614	627	21%
1939-40	P.184	1,485	1,408	1,307	14%
Average:	Two seasons	1,122	1,011	967	17.5%

Close planting has given a definite increase in the acre yield in both seasons. In the season which was less favourable to growth, owing to excessive rains and low average tempera

tures, the benefit derived from close planting was more marked than it was in the second season when climatic conditions were favourable and a more robust variety was planted. These results indicate that the yellow-seeded varieties are not likely to return the heaviest possible yields per acre when the rows are widely spaced, and so in field practice it is advisable to plant the rows as close as the tillage implements will allow. These trials were made on land of medium fertility. It may be mentioned that in other trials where the land had been recently dressed with farmyard manure there were indications that a spacing of 24 inches between rows was not too wide. It is seen, therefore, that the optimum spacing will vary according to the fertility of the land and the type of growth natural to the variety being cultivated.

Velvet Bean Hybrids.—Although the fodder of this plant is not as palatable to livestock as that of soya beans, cowpeas, etc., its ability to resist extreme conditions of climate and soil and to produce large amounts of foliage and seed, make it one of our most popular fodder crops. The seed of two new strains, *viz.*, Marbilee and Jubilack, which have been evolved at this Station as a result of crossing the Somerset variety with another late-maturing, light-seeding kind, were issued to farmers in small quantities at the end of the season under review. A report explaining the reasons for considering them superior to the Somerset strain was published in the October, 1940, issue of this *Journal* and is now available as Bulletin No. 1164. The strains issued are not entirely homogeneous and the work is being continued with a view to improving them in that respect.

Pyrethrum.—During the season under review the plants in our trial plots were allowed to produce seed, all the medium and low-producing plants having been removed. They were afterwards further reduced by the transfer of a large number of the plants to the Rhodes Estate at Inyanga, and issues to farmers who wished to give the crop a trial. Issues of seed have been made to over sixty farmers in various parts of the Colony. Owing to the lack of facilities for irrigation, investigational work at this Station must be on a limited scale for the present.

Housing and Feeding Adult Poultry Stock

By H. G. Wheeldon, Poultry Officer.

PART II.

FEEDING.

The fowl by consuming raw materials in the form of food effects the transformation of comparatively cheap foodstuffs into remunerative products for human consumption. The main purposes for which poultry are kept are for the production of eggs and of meat. The public demand is for good flavoured fowls for table purposes and well flavoured eggs with a richly coloured yolk. In order to effectively transform raw materials to edible products, the birds must be supplied with foods that will best meet their requirements for health and maintenance and the ration should be based on a nutritive ratio that would be most suitable either for egg production or for fattening purposes. A knowledge of the nutritive value of the various food constituents is necessary, as well as a knowledge of how to apply them to the best advantage for the particular object in view. A fattening ration given to laying birds would not suffice for maximum egg production, or stinting the quantity of food to a mere maintenance ration for adult and growing stock will not give profitable results in egg production or satisfactory growth and economical gains in weight. A ration containing excessive fibre may have a similar effect, in which case, although the crops of the birds may be filled to capacity the digestible nutrients might be insufficient even for the proper maintenance of the stock. The value of a ration depends on its digestibility, as only the digestible portion of the food consumed is absorbed and becomes available to the bird for maintenance and growth, or the production of eggs.

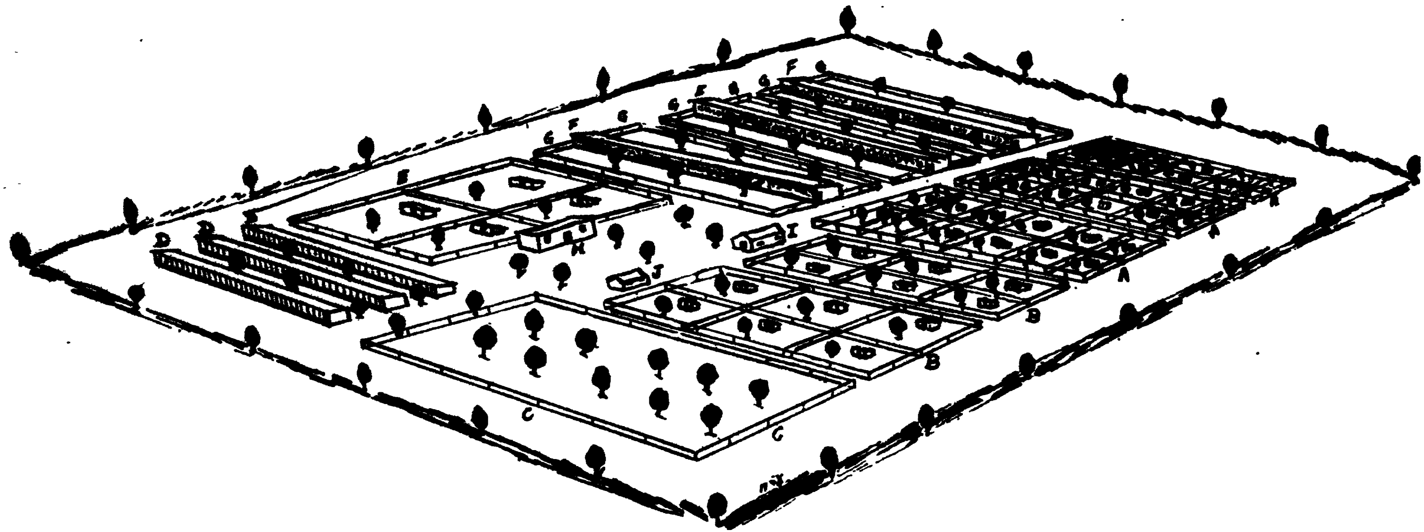
The successful poultry farmer realises by experience that the various kinds of wholesome grains which can be grown or might be available on the market are not all equally well suited for feeding to poultry. Consideration must be given first to the selection of foods that are palatable to poultry and easily digested by them, secondly to supplying the foods combined in such a form that they will achieve the purpose for which they are required in the shortest possible time, without waste.

The successful selection and blending of rations, therefore, depends upon a thorough study of the principles underlying the feeding of poultry and the economical use of the various available foodstuffs, together with a knowledge of the essential requirements of the birds.

Whatever the nature of the foods may be, their nutritive value is determined by the presence or absence of the following substances—protein, carbohydrates, fats and oils, water and necessary food substances such as vitamins and minerals. Nearly all of the cereals commonly fed to poultry contain more carbohydrates and fats and less protein than the fowls require. Protein is the most difficult and expensive part of the ration to supply.

The first demand on the food consumed by laying stock is for maintenance such as the replacement of waste tissue—a process which is constantly going on; besides development, energy and the temperature of the body must be secured. These functions are essential for the birds to live, and for their general well-being. When the requirements for maintenance are fulfilled, not till then, the surplus nutrients in the ration go to the manufacture of eggs, or if it be for table poultry the ration must be a fattening one. For economical egg production or fattening it is important that the ration should supply as much nourishment of the right kind in excess of that required for maintenance as the birds can consume.

A properly balanced ration is a combination of palatable foodstuffs supplying the necessary nutrients in the correct proportion to produce the highest and most economical production of eggs, the nutritive ratio of which should be 1:4.5. The ratio of a fattening ration should be 1:6.



PERSPECTIVE VIEW OF A BREEDING AND COMMERCIAL POULTRY FARM.

A, runs for growing chicks; B, breeding pens; C, camp for brooder chicks; D, single pens; E, pens for breeding ducks or turkeys; F, laying houses; G, duplicate runs to each house (F); H, store; I, incubator house; J, office.

Trees—fruit or ornamental. Area of land required—5 to 10 acres.

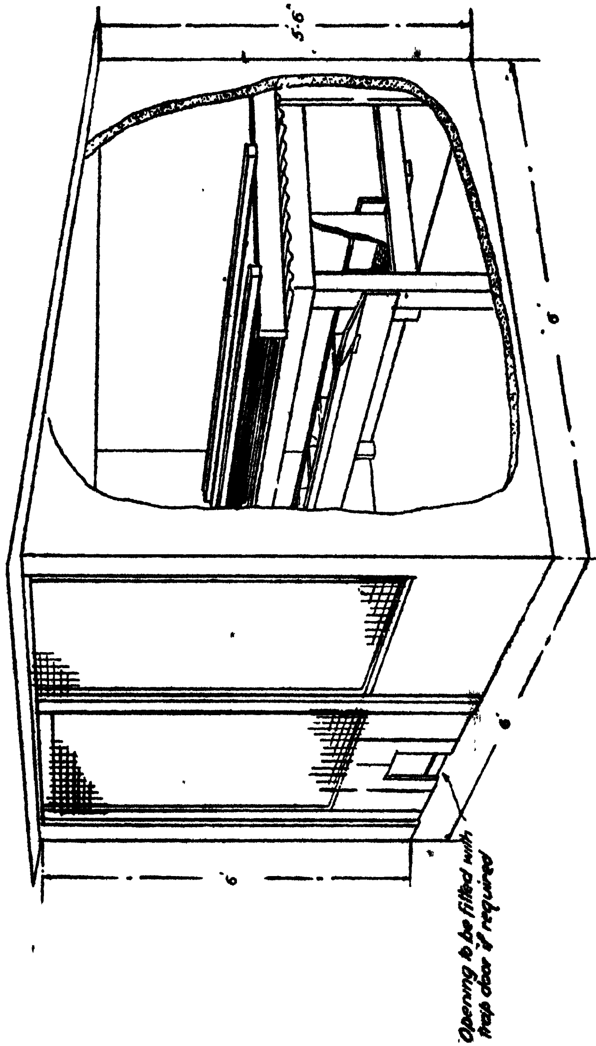


Fig. 2.—Breeding pen. showing arrangement of nests, dropping board and perches.

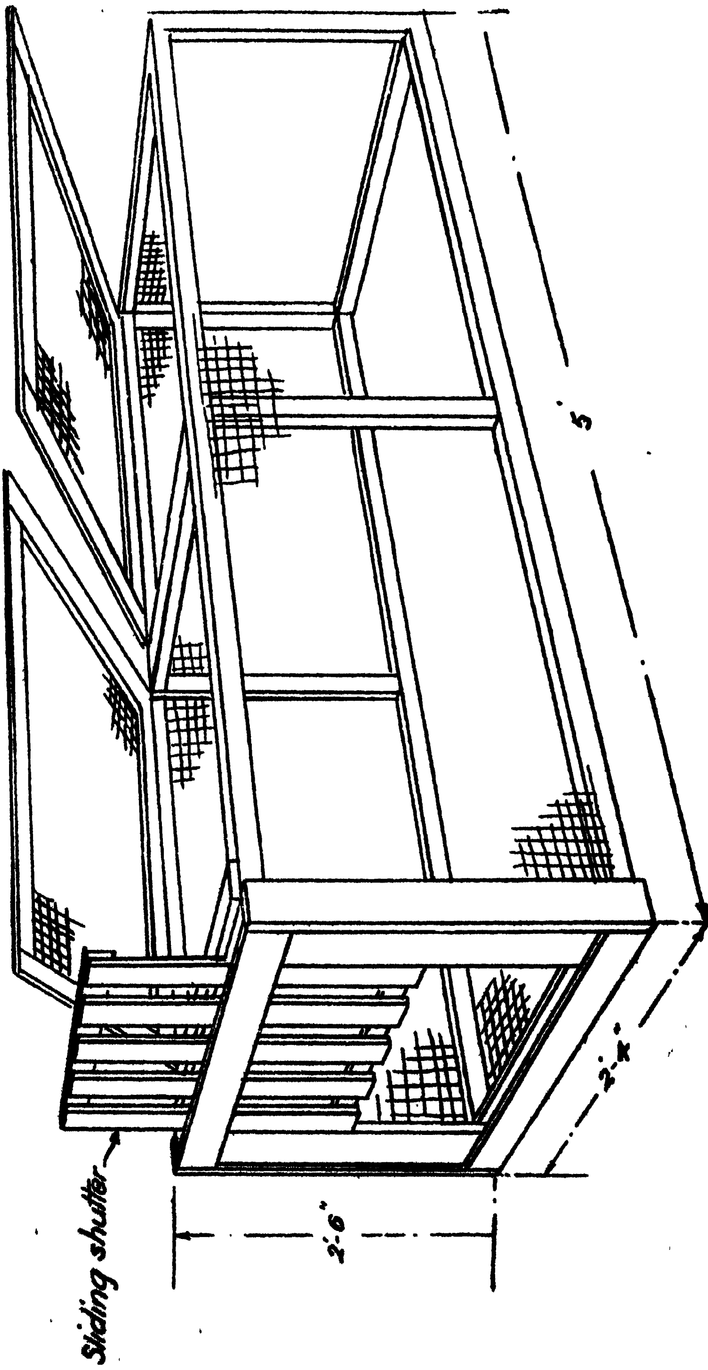


Fig. 4.—Catching crate

Poultry, as with all livestock, therefore, require a consistent supply of food always sufficient in quantity and quality. If the supply of food is curtailed for instance to a bare maintenance ration with regard to protein, laying birds would cease to produce eggs. On the other hand if the supply exceeds the demand for maintenance it would stimulate the production of eggs, or in the case of moulting birds the quick growth of new feathers and also ensures the robust growth and development of young stock. An abnormal supply of protein, besides being wasteful from the point of view of expense, may cause disorders. Carbohydrates are a source of energy, and if given to excess are generally stored in the body as surplus fat. It is only the food left after the maintenance demand is satisfied that becomes available for the production of eggs or meat. Thus in the feeding of farm livestock the terms "maintenance ration" and "productive ration" are not infrequently used. This is all-important in practice because the food supplied during the egg laying period has not only to contain the materials for maintenance of the vital activities of the bird itself, but it has, in addition, to supply the raw materials for the manufacture of eggs, whether few or many eggs are produced.

High egg producers are large eaters as a rule; the demand on their system is greater, and to obtain a profitable egg yield the food should not be stinted either in quantity or quality if the functions of food are to be maintained to the best advantage. The stinting of food when practised for economical reasons is definitely false economy.

It cannot be too strongly emphasised that from a quantitative standpoint it is necessary to secure that sufficient carbohydrates and protein are present in the daily food consumed to ensure adequate production, and for this a full ration is required to fully satisfy the stock. With regard to quality, it must contain an adequate amount of the necessary vitamins and mineral salts and it is essential that the mixture of foods used must be palatable and wholesome.

It will be observed from the foregoing that the growth of young stock might be retarded, or the production and well-being of adult stock impaired, by supplying insufficient food

or rations that may be unsuitable for their nutritional requirements—whether for eggs, meat or the sturdy growth of young stock.

Poultry foods consist chiefly of cereals and cereal by-products, green foods, and by-products of animal origin. In compiling rations for any given purpose, it is important, apart from the nutritional aspect, to pay careful attention to the fibre or bulkiness of the food, a point which is too often overlooked in connection with poultry rations. Woody fibre does not play any very important part as a source of food, although fibre derived from some food substances undergoes a certain amount of digestion in the digestive tract of the bird.

It is possible to compile a perfectly balanced ration but which may contain excessive fibre or bulkiness, and obviously in constructing rations for any given purpose it is essential to pay strict attention to the fibre content. It is not safe to rely solely on the albuminoid ratio as a basis for compiling poultry rations, as it gives no indication of the bulkiness of the ration. It is possible to compile two rations similar in albuminoid ratios, one proving satisfactory and productive, while the other may be the reverse because of excessive fibre. A ration may contain all the nutrition theoretically to meet the demands, but the surplus of fibre may prevent its satisfactory assimulation. Much the same applies to supplementary food substances such as vitamins and mineral constituents of which a ration with a given albuminoid ratio may be deficient.

With dry mash feeding where hoppers are constantly open and the flock allowed access to the food *ad lib.*, proper adjustment of the volume of the ration by the judicious use of a bulky food such as wheaten bran can be made to maintain the birds in good condition with a satisfactory level of production, but if a given ration for laying stock be overloaded by fibrous foodstuffs, egg production in the main would be disappointing and the stock would fall off in condition.

As already observed, the problem of economical feeding from a quantitative viewpoint is to compile a ration that will supply the bird daily with (1) its maintenance requirements of digestible protein and carbohydrates and (2) its production

requirements whether it be eggs or meat. The birds must have sufficient protein and other food constituents for their requirements, but nothing will be gained by feeding more than they require. A mash that has proved satisfactory in the first year's laying will be equally suitable for second season stock and there is no advantage in changing it. The rate of egg production depends upon the laying condition of the birds and their fecundity. The feeding must be designed to maintain a satisfactory condition for egg production in order to promote to the fullest extent the inherited productive capabilities of any given strain.

The systematic feeding of poultry from a practical standpoint also deserves careful attention. Healthy fowls on free range begin their search for food at dawn and continue in restless activity until the close of the day forces them to roost. This activity should be maintained as closely as possible in the management of stock kept in confinement. A flock confined in houses and runs is compelled to rely on the convenience of those who care for them. Poultry are creatures of habit and if irregularly attended to they become restless, discontented and insist on flying out of the pens; regularity in the routine is a matter of great importance. If over-fed with no exercise they become lazy and over-fat, and if the food is insufficient they neither prosper in health nor will they produce eggs. To maintain a flock under proper conditions the birds should have access to food and water when needed, at dawn on leaving the roosts, and they must go to roost with full crops. The birds will adapt themselves to any system of management convenient to their owner, provided regularity in the routine is practised.

A dry mash should be supplied in hoppers for the birds to help themselves, and the grain for hens confined in houses or when on free range should be well scattered and so planned that they must scratch for it, preferably in straw or grass The grain food should be scattered in the litter on the floor inside the house or otherwise in litter provided in a scratching shed or the yard. The food should not be supplied in wet, dirty or mouldy litter and all food utensils should be clean and regularly replenished with food and water.

Exercise.—Without exercise the birds become lazy and overfat and they develop vices such as feather eating. The litter should not be too deep and heavy but normally about 6 inches deep, loose, dry and conveniently moved by the birds when hunting for the grain. Exercise, that is, hunting interestedly for the grain rather than laborious work which disheartens the birds, is necessary to maintain health and to stimulate the appetite and egg production. Productive birds under suitable environment are usually active and interested in their surroundings; such birds are healthy and good producers as a rule. Under good management in the intensive or semi-intensive systems, fowls will be noticed continually hunting for grain and actively dividing their time at the mash hoppers and other utensils. The best layers would be in good condition and restlessly hang about the nest boxes during part of the day. Such birds seldom develop bad habits. If the birds obtain their fill without effort, especially the grain food, they soon become content and inactive, followed by overfat condition; a poor egg yield, and ailments, or the development of vices is the result. In feeding the grain it should be well scattered in clean litter or some form of covering to induce reasonable exercise, and the quantity of grain food regulated according to their requirements and production.

Variety in the Di t.—The appetite is stimulated and the digestion improved by a variety of grain and other mixed foods. The value of variety in feeding has long been realised. There is no one food that will answer every purpose, conse quently to provide the full maintenance requirements a variety of mixed foods is desirable. In every locality there are some kinds of foods available which are suitable for poultry and from such grains it is sometimes possible to select a wholesome diet. Maize is a staple food and is produced in most areas; in some localities kaffir corn may be readily available. They are similar in food value and either of these could be used as a basis for the grain mixture, fed separately or mixed together. In this Colony other useful grains to incorporate in the grain mixture are munga or N'yati, and to a limited extent the small variety of sunflower seed. A mash mixture of cereal bye-products provides the protein requirements, and taken in conjunction with the grain

furnishes a balanced ration. Green food and animal food are also necessary for the well-being of the stock. Although such foods are necessary for proper maintenance and health, two or three grains and a mixture of cereal bye-products and animal food ensures the required variety in the diet for all practical purposes for an indefinite period.

A given ration when used continuously will not answer unless it is itself a balanced ration, consisting of a variety of palatable grains and meals, and the consumption to some extent must be regulated to suit the requirements of the flock as a whole.

Changing the Diet.—A change in the diet may react favourably or adversely on the birds. Adverse effects can be minimised by making any necessary change gradually, but sudden changes in the composition of the diet are not advisable in the case of hens in full lay. Supplementing the dry mash with a feed of the same mash moistened, for instance, as a variety in the system of feeding, would not be harmful. Any other seasonable variation of suitable grains for poultry that are similar in composition, methodically carried out, will not have a deterrent effect but would more likely maintain a steady average production throughout the year. If hens are not laying well because of an unsuitable ration, and a complete change to a suitable ration were made, it frequently has a stimulating effect with improvement in production. Erratic or sudden changes in the diet of birds in full lay will curtail their production and may cause the birds to moult. Although drastic changes in the diet generally do more harm than good, if judiciously carried out improvement is often the result. Young stock, particularly early hatched pullets, are very susceptible to changes in feeding and quarters. The birds should be penned in their permanent quarters just before production begins. Every care should then be taken to see that changes are not made in the rations of which they are accustomed. If it must be done, any change should be done gradually over a period of several days.

Fat forming foods are generally chosen by the birds first. It is a natural tendency both for old and young poultry to select fattening foods to accumulate fat in order to provide

against lean times, which foods to some extent must be controlled in the case of commercial flocks. If they are excessive in the ration the birds are likely to fatten. To avoid this, in the mature laying flock only the required amount of fat forming foods, especially the grain food, should be available to them. The grain mixture contains the greatest amount of fat forming foods and a suitable mash is rich in protein. By consuming equal quantities of grain and mash daily the birds will obtain their requirements, properly balanced for egg production. If according to observations by the attendant, the birds are too heavy or fattening and not laying well, a change by limiting the quantity of grain is recommended, with access to the mash *ad lib.* until the birds come into production. This applies particularly to second season birds after their moult and during the time of moulting when they usually tend to fatten. For birds that are laying heavily and losing condition or birds that are too lean, a full ration of grain should be supplied. A full grain ration to pullets for the first few months after commencing to lay would serve to maintain their condition and production. As will be observed, there is a special purpose in these adjustments in the feeding that should act beneficially as a variety in the diet. It should be practised in conjunction with intelligent observation of the flock in an endeavour to maintain as far as possible the condition of the stock with the main object of obtaining a maximum average production of eggs. Such variations in the feeding are practical and desirable methods of securing good results. The results achieved depend upon the judgment and ability of the attendant, and whilst the amount of grain supplied should be regulated to suit the requirements of the birds, a standing rule should be to supply the mash *ad lib.* without waste.

System of Feeding.—Poultry may be successfully fed by the use of a system in which dry food alone is used, or by one in which part of the food is given as a moist mash. A definite system of some kind must be followed, as regularity is important in the management of poultry. The cereal foods should consist of two parts, namely, grain and mash, unless an all-wash ration is supplied.

Dry Feeding.—The system of dry feeding is now generally adopted by the commercial farmer for laying flocks in large numbers and for rearing chickens. Cereals in a natural or milled state can be used to compile suitable grain and mash mixtures and other necessary bye-products of wholesome foodstuffs such as animal foods and leaf meals may be fed in a dry state mixed in the mash. It is a labour-saving system and is probably more beneficial to the birds than total moist mash feeding. Dry foods are more easily handled, and supplying the mash in self-feeding hoppers or the open trough type of hoppers ensures the daily supply of mash food for a given period, the birds being allowed to help themselves. Dry mash should be accessible to the birds *ad lib.*

Wet Mash Feeding.—Feeding systems other than dry are grouped under the term moist mash feeding. Although this system previously was the general practice on poultry farms, it has now been replaced by the dry feeding system, except as a supplementary feed for laying hens and growing stock. It, however, plays an important part in the feeding of birds required for table purposes. Cooked or boiled foods are used to a much less extent. Mash foods moistened with water, milk or the gravy of boiled offal should always be fed in a crumbly state. It is used for laying and growing stock as a change, chiefly to stimulate the appetite, and serves as a variety in the diet when the birds are noticed to be off their food, thereby inducing them to consume a full ration. It is useful as a supplementary food during adverse weather conditions when accompanied by a declining production of eggs, or for chickens when noticed to be flagging. Apart from this, moist mash should be the main diet for waterfowl or birds in the fattening pens for table use. In all cases sufficient in quantity should be supplied at each meal to be consumed readily within a given time, usually half an hour.

Grains and Meals.—Fowls are omniverous; they require grain and its bye-products, green food and animal food. Mealies, munga, wheat and sunflower seeds are some of the most suitable Rhodesian grown grains to feed to poultry. Other grains such as beans, kaffir corn, buckwheat, rapoka, are not readily available and owing to their cost, or lack of palatability, and their composition in some cases, they are

generally not included in the rations, and if they are, their use is limited by the extent to which it may be possible to use them to the best advantage. Maize, wheat or munga, can be fed alone better than sunflower seed; well filled sunflower seeds are palatable to poultry and they should be included in the grain mixture, and although particularly useful for birds in the moult, this grain may be fed to the birds throughout the year. Owing to the oil content it has a desirable effect on the plumage of birds, but its action on the digestive system necessitates its use to a limited extent. Of the bean varieties kaffir beans or cowpeas and soya beans are perhaps the most palatable, but they are not freely consumed, except to a limited extent. A mixture of whole or crushed grains (having crushed maize as the basis of the mixture) consisting of two or three suitable kinds can be fed to advantage. In countries where wheat is extensively grown and, therefore, economical in price, this grain may be fed extensively alone or utilised as the foundation of a grain mixture. Although wheat, maize and munga can be fed continually as single grains in conjunction with a suitably balanced mash, it is advantageous to include in the grain food a variety or mixture of grains such as, in this Colony, maize, sunflower seed and munga.

A mash should be made up of palatable wholesome bye-products of grain as a basis in which other necessary food constituents can be conveniently incorporated, such as animal food, mineral salts, and with advantage a proportion of the green food in the form of leaf meal. Wheaten bran, pollard and mealie meal with animal food form the basis of a good mixture for adult stock. They should be mixed in suitable proportions to form a balanced ration with the grain food. As a rule a simple ration is all that is necessary, consisting of easily available grains and their bye-products, or, as far as possible, suitable farm-grown products can be used as supplementary foodstuffs at economical costs. The most simple, efficient and economical farm-grown ration that can at present be recommended is maize, separated milk and green food.

Only grains and meals of good quality should be fed to poultry; damp, musty or mouldy foodstuffs should never be

used. To obtain the best results nothing but plump, sound, well-matured grain and good quality bye-products should be selected. Poultry farmers are often far better judges of their stock than they are of the foods selected to compile suitable rations for feeding stock.

Animal Food.—The birds must be supplied with animal food of some kind, either in the form of meat meal or fish meal, at the rate of 8% or 10% of the total ration. The quality of these must be good; their food value is based on the protein content and the monetary value may vary accordingly. When a smaller percentage is used there is a tendency to feather plucking, cannibalism and possibly smaller eggs, and a tendency for the birds not to gain weight as a healthy pullet should do when in production.

Meat meal is esteemed as a protein rich food for addition to cereal rations. It requires to be supplemented with minerals when used for poultry. Meat and bone meal is another useful protein rich food. The presence of bone renders it a desirable food for laying and growing stock. Owing to the varying admixture of bone, the meal should always be purchased on its protein percentage basis. Poor samples of either show an excess of gristle, hide, hair and oil, and when stored turn rancid, and in the case of meat and bone meal an excess of bone may be present. Good samples of meat meal are usually golden in colour with an appetising aroma and containing 50% to 60% protein not less than 40%. Fish meal is an extremely useful protein rich food both for young and growing stock and for layers. It should be low in oil content and light in colour. Its mineral content as well as the protein present renders it a sound supplementary food for cereal rations. If fed up to 10% of the ration there is not much danger of taint in either the flesh or eggs.

Blood meal has a high percentage of protein, but as it is not palatable to poultry it should not be included to a great extent in poultry rations. Thick separated milk, monkey nut cake meal and extracted soya bean meal are examples of useful protein foods which can be used to advantage in poultry rations to replace a proportion of the animal food. Separated milk, either fresh or sour, may be used for mixing a moist

mash, or the milk after being allowed to thicken or coagulate may be fed separately in troughs or other receptacles for the birds to help themselves.

Monkey nut cake meal and extracted soya bean meal are both valuable protein foods and a useful vegetable protein in composition approximating that of milk. When these meals are fed, mineral supplements such as steamed bone meal, lime and salt should be added to the ration.

Green Foods.—Succulent green vegetation or suitable leaf meal of some kind forms an important part of the diet of poultry. This applies particularly to birds kept in the intensive systems and during the dry season under whatever conditions they may be kept, especially so in this hot climate. Without green food, or if not supplied in sufficient quantity, the stock cannot be expected to produce eggs or make satisfactory growth, nor will they remain healthy. Apart from other dietetic qualities, green foods are the chief source of Vitamin "A," a deficiency of which causes nutritional roup. Yellow maize has an appreciable amount of this vitamin, but other cereal grains are deficient in this respect. Poultry without sufficient green food are deprived of the vitamins necessary for their well-being, and nutritional disorders and undermined constitutions are traceable to this deficiency.

Every endeavour should be made by poultry farmers to produce green food throughout the year, or provision should be made to supplement succulent green foods in the dry season by leaf meals. Lucerne, lettuce and young sunflower leaves are good examples of suitable summer grown green foods. Cabbage, kale and rape are all useful in moderate quantities; if given to excess alone they are liable to taint and even discolour the contents of eggs. Chinese lettuce is easily grown in winter and is an excellent food for poultry. Lucerne and sunflower leaf meals consist of the dried leaves made into a fine meal by disintegration.

The meal when properly cured should be a rich green colour. They are rich in protein and similar in value as green food. Lucerne leaf meal is available as a commercial product, but sunflower leaves could be collected and dried on the farm for converting into leaf meal, also the use of dried

sunflower leaves fed even in a coarse state after soaking in water is an excellent substitute for green food and could be made available by all poultry farms to overcome the problem of green food in the dry season. The dried leaves can be stored for several months and fed to the birds in conjunction with the dry or moist mash. The leaf meals can be used to substitute succulent green vegetation if supplied in the mash, or soaked in water and fed separately in troughs after draining off the water. Other useful green foods are green barley, onion tops, swiss chard, willow leaves, edible canna, and sprouted oats, barley or wheat. The grain for sprouting should be soaked overnight in water and spread out one half to one inch thick on hessian covered wire trays or half paraffin tins with perforated bottom to facilitate drainage, and placed for convenience in a stand for sprouting under overhead cover such as a verandah. The grain should be kept moist by daily sprinkling with water when it will soon sprout and make satisfactory growth for use, the weight of grain used increases approximately threefold when sprouted. Sprouted grain should be fed when the sprouts are two to three inches long for adult stock. The sod is removed from the trays when ready and broken into pieces about 2 inches square per bird and fed in troughs or on some other clean surface daily. Sprouted grains are ready for use under good conditions in about a week after germination commences. In order to obtain uniform germination the moist grain should be stirred or mixed daily until all the seed has germinated, then lift to set. Light and ventilation are necessary for the growth of the sprouts. As the trays are emptied they should be washed in a 5% solution of formalin and exposed to the sun to dry out; this, in addition to good ventilation, minimises the development of mould.

In the case of laying stock, the use of green foods gives a rich colour to the yolks, even when the birds are kept under intensive conditions.

Mineral Constituents.—The chief requirements for poultry consist of calcium, phosphorous, sodium and chlorine. Other minerals are generally present in ample amount in the foods used. All the minerals are better assimilated in their natural state. The mineral content of normal foodstuffs is generally

adequate to meet all the demands of poultry. The requirements of adult stock are not nearly as great as those of growing stock.

Calcium or lime is present in bone bye-products, such as steamed bone meal, in limestone, and oyster shell. When limestone or oyster shell is used either as a grit or powder it should possess a good percentage of lime.

Phosphorous present in all naturally occurring proteins and in bone meal.

Sodium given always as common salt in the ration.

Chlorine is supplied by giving common salt.

Salt and lime are probably the most important factors, and of these salt is the most important mineral supplement. Salt should not exceed 1% of the ration, and should be incorporated in the mash for adult or growing stock evenly distributed and thoroughly mixed at the rate of ½% to 1% in all mash rations.

Oyster Shell or limestone grit should be accessible to the birds in boxes or tins. Lime is necessary for the formation of egg shells. Without one or other of these sources of lime soft shelled eggs may be the result. Powdered limestone can be included in the mash mixture at the rate of 2% when oyster shell is not supplied.

Grit is necessary to aid the assimilation of food. Its function is to grind the food on entering the gizzard of the fowl and in effect replaces the teeth of animals. The best grit is hard and irregular in shape. Hard limestone grit is valuable also as it helps to grind the other foods and is itself partly assimilated forming egg shells and bone. It should be understood that oyster shell cannot take the place of grit.

Charcoal.—The real value of charcoal remains questionable, but it may be presumed to be a corrective and an aid to digestion. Poultry are certainly fond of it and it may be liberally supplied to them broken into small pieces placed in hoppers or tins.

Drinking Water.—One of the first requisites for successful poultry feeding is an adequate water supply. As a part of the daily ration clean drinking water is equal in

importance to the cereal ration. The blood, tissues of the body and the eggs produced are all largely composed of water. Water is an absolute necessity for the poultry, and growing green crops. If the drinking water is sun-warmed, stagnant or contaminated, disease or other disorders are sure to follow its use. A continuous supply of clean water is necessary by replenishing the water vessels twice daily and constantly kept within easy reach of all the birds, from which they can help themselves at will. The water should be protected from the rays of the sun, placed in the shade of trees or within the poultry house to avoid sun-warming, which results in digestive disorders. The vessels should be so arranged as to prevent the birds from overturning them or standing in the water. They should be cleaned daily and once a week washed in a disinfectant solution. Petrol or oil tins have been extensively used and as supplies become more difficult to obtain the use of other available materials requires consideration. For this purpose water vessels can be made of cement economically in suitable metal moulds.

Undesirable Foods.—Undesirable foods are foods of poor quality and those unpalatable to poultry. Foodstuffs of inferior quality should not be included in the ration for poultry because of their cheapness or because they may be available on the farm such as at the time of threshing. Grains which are light in weight, shrivelled or immature and usually encased in hulls are not generally wholesome foods. They lack digestible substances and on account of excessive fibre they are no better than straw. Spoilt grains or fermented and mouldy foods are undesirable, they are frequently a source of enteritis or poisoning. Although such foods may appear to be wholesome they have deteriorated and due to the presence of mould and other factors of a detrimental nature they should be avoided at all costs. Unpalatable foods will be either left unconsumed or taken only to a limited extent.

Rations and Management.—The object in feeding poultry as with all classes of productive stock, is to obtain the maximum profitable results. In managing a commercial plant the basis upon which to work, apart from feeding rations which in practice are accepted as the most economical compatible with efficiency, it is necessary to keep a constant check on the normal maximum production of the flock and

satisfactorily to maintain the average production throughout the year. Secondly, it is necessary to endeavour to take full advantage of the seasonal price fluctuation during the scarce season when egg prices are high. With this in view one of the most important factors is discretion in the method of management. The condition of the stock, and hence their productivity, can be well maintained by judicious feeding, this means regulating to some extent the quality of grain and mash consumed in accordance with the laying condition of the flock. Their nutritional requirements must be met and for the best results the stock should be kept in a lean, hard laying condition, active and healthy. This applies to mature egg laying flocks of all the popular breeds, and it will be observed by experience that the heavy breeds and old birds require more attention to keep them productive and active, and so prevent them from becoming overfat. Generally, the best single guide by which the condition of thrifty stock can be observed and the basis upon which to regulate the feeding from time to time is the productivity of the flock. Whilst pullets commence to lay in a soft, plump condition and in full lay they tend to exhaust their physical capacity and lose weight, in contrast the condition of good productive mature birds is usually lean and more stable, the unproductive birds tend to become overfat and lazy and discretion is necessary to guard against these tendencies. The young stock on reaching laying maturity are not fully developed and with satisfactory feeding they continue to fill out, irrespective of their production, they should increase in weight until fully mature at 12 months old. It will be obvious that in the case of both hens and pullets an effort must be made to regulate the rations according to these requirements and so to maintain their condition to ensure a maximum production. Hens and pullets respond better when housed separately, they require different treatment and there is no short cut in this matter; indiscriminate methods of feeding and management mean storing up trouble, followed by unsatisfactory results. Unless the condition of the pullet flock—the most profitable source of revenue in the scarce season—be well maintained during their early production period the reaction is likely to be an unseasonal or pullet moult with low egg production. Pullets require liberal feeding and a full grain ration until maturity

is reached. It is the condition of the birds that counts. Any system that ensures good condition will also ensure good production. In the case of pullets under-nourishment is a contributory cause of unseasonal moulting and the rations should not be too stimulating.

Hens that are laying well are seldom fat, but their weight increases rapidly as the egg yield decreases. Pullets that are in the peak of production consume more food than do hens; two year old hens increase in weight more rapidly and lay fewer eggs and consume less food than do the pullets or yearlings. Birds up to the age of 12 months are styled "pullets," those from 12 to 24 months "yearlings" and over 24 months are termed "hens."

Poultry should consume all the grain fed to them each day, if this is not done it generally indicates over-feeding and the amount of grain should be reduced, unless the grain is of inferior quality or unpalatable to them. The flock under good management will show keenness on the grain ration at the regular time of feeding although having access to the mash *ad lib.*

During the Spring months the question of satisfactory egg production seldom arises, practically all birds are laying and should be producing well; eggs are naturally plentiful with over supplied markets and low prices. At this season of the year mismanagement may result in another pitfall. Egg production is referred to as almost mechanical as if it were purely a matter of feeding, and simply a question of economising in food when prices are low and resort to liberal feeding when egg prices rise; the birds are thereby expected to react by producing eggs just when required to do so. In practice, however, this theory falls short of expectations, and at this season of the year it is well to remember that "the best means of maintaining the condition of the mature flock of birds satisfactorily is to keep the birds laying."

A reduced egg yield due to stinting the rations cannot be compensated by better production later, on the introduction of liberal feeding. The result of such economy is deterioration in condition, and possibly the cause of early moulting.

Birds in full lay require proportionately larger quantities of food than when they are normally unproductive and should be supplied with a full ration irrespective of the price of eggs. Any economy which may be necessary should not be carried out at the expense of the laying flock and the risk of loss such as by feeding grain excessively and cheap foodstuffs of inferior quality or to restrict the consumption of the ration as a whole. It would be preferable to take full advantage of culling out the old or unprofitable birds and the opportunity to re-group the stock. A practice by which economy in the cost of food could be effected also making available housing for the young stock and possibly a saving in labour and increasing the returns by the sale of surplus stock at a time when egg prices are low.

When pullets and hens are kept together and fed as one flock, their condition will be affected one way or the other, with a drop in egg production. The pullet flock, for example, after coming into production will stand rather liberal feeding on grain which should lessen the consumption of mash. A flock of second season or older birds requires a larger proportion of the mash ration to prevent them from becoming over-fat. Although a similar ration of grain and mash may be used, it is possible to control the condition and production of the flock by regulating the amount of grain fed with the mash accessible to the birds *ad lib.* The consumption of mash is encouraged by restricting the quantity of grain and would promote egg production. To maintain a satisfactory production, mature birds in good laying condition should consume equal proportions of grain and mash. The normal average capacity of a fowl is approximately 4 ozs. of food daily, of which 3 ozs. represents grain and mash; individual heavy producers might consume as much as 5 or 6 ozs. of food daily. A ration becomes more stimulating for egg production as the consumption of mash is increased, conversely the consumption of a greater quantity of grain than mash would improve the condition of the stock. If pullets are losing weight because of heavy production, as they do invariably in the early part of the season, a greater proportion of grain than mash should be supplied to them.

A cessation in egg production, therefore, may be caused by one of two factors in a well fed flock of birds:—

1. Lowered condition among pullets, caused by a too stimulating ration and forced egg production. The natural reaction to which is a "pullet moult." They benefit by consuming a greater quantity of grain food in the early part of the season.

2. A wide or otherwise fattening ration to hens results in the birds becoming overfat followed by a decreased egg production. This can be minimised by allowing more mash than grain in the daily ration.

By keeping a daily or weekly check on the normal maximum production of a flock and by examining the condition of the stock from time to time if necessary, adjustment in the feeding may be carried out to meet these requirements. Whilst the successful management of the laying flock depends to a considerable extent upon the judgment of the attendant and feeding methods, a good general practice in the case of hens is to provide them with more mash than grain, even during the moulting period. They should be encouraged to exercise by scratching for the grain which should be placed in clean grass litter. The feeding of grain in hoppers which is sometimes practised should be additional to the scratch grain and would be more advantageous for the pullet flock.

A knowledge of the most suitable method of feeding, seasonal adjustments and whether the birds are satisfied and in good laying condition must be gained by observation and experience. The birds should go to roost with a full crop, and invariably the mash should be supplied *ad lib.* to make sure they are fully satisfied.

The grain may be fed twice daily during the winter months, preferably in litter on the floor of the house. A small quantity of grain about ½ oz. per bird given in the early morning will encourage the birds to exercise during the day, the remainder of the grain ration should be given during the afternoon. Munga is one of the best scratch grains to feed in the morning, being palatable and small the birds will work hard for it. During the hot months munga could be included in the grain mixture and fed once a day during the afternoon.

It is not possible to have the grain and mash rations separately balanced. The mash contains an excess of protein.

termed a "narrow ration." The grain contains more fat forming material than is required for egg production, but the combination of mash and grain consumed in equal quantities forms a balanced ration for egg producing purposes.

The following rations have given good results:—

Standard Laying Ration. Mature Stock	Parts by Weight.
Bran	125 lbs.
Pollard	125 lbs.
Mealie Meal	100 lbs.
Meat Meal	100 lbs.
Lucerne	50 lbs.

Standard Breeding Ration and for Pullets	Parts by Weight
Bran	125 lbs.
Pollard	125 lbs.
Mealie Meal	100 lbs.
Meat Meal or Fish Meal	75 lbs.
Lucerne or Sunflower Leaf Meal	50 lbs.

N.B.—If Leaf meal is omitted add equivalent weight to bran.

Grain.		Mineral Mixture.	
Crushed Mealies	50 lbs.	Bone Meal	55 lbs.
Sunflower Seed	10 lbs.	Common Salt	20 lbs.
Munga (optional)	10 lbs.	Ground Limestone	20 lbs.
		Sulphur	5 lbs.
		Mix 5 lbs. to 100 lbs. Mash.	

The discussion in these notes may leave the impression that poultry farming is a hazardous enterprise; when poultry are kept in a haphazard manner this does apply, but with reasonable care and methodical attention poultry respond satisfactorily and it is possible for the careful poultry farmer to maintain the stock in a profitable and reasonably disease-free condition. Essential factors linked in the chain of management to obtain a satisfactory egg production in the off-season are the care and attention given to the growing pullets and laying flock.

It is on the production secured when egg prices reach a high level that the success of the plant for the year largely depends. In order to obtain satisfactory egg production at that time which must be considered out-of-season as the natural laying season for hens is the Spring, the details of management up to that period and through the production stage must be carefully and intelligently observed. Poultry farming has been described as a matter of observation, and although this is largely the case, a great deal depends on the correct interpretation on what is seen. Success is not dependent on hard and fast rules. The system of feeding and management should not be rigid but flexible within limits, so that modifications may be made to suit the requirements of the stock for the maximum production of eggs.

Propaganda Panel.

THE FLEA.

One, two, three,
Mother saw a flea.
A little bit more cleanliness
And out goes he!

—*Cleaniness Aids Insect Control.*

Cleanliness is mighty in the sward. Also in lands and buildings.

Southern Rhodesia Veterinary Report.

MARCH, 1941.

DISEASES.

African Coast Fever was diagnosed on the farm "At Last," in the Salisbury native district, and on "Kwesfontein," in the Charter native district.

TUBERCULIN TEST.

Twenty-three bulls and 125 cows and heifers were tested on importation. There were no reactors.

MALLEIN TEST.

One horse was tested with negative results.

IMPORTATIONS.

Union of South Africa.—Bulls, 30; cows, 119; horses, 2; sheep, 656; goats, 3.

Bechuanaland Protectorate.—Sheep, 478; goats, 32; pigs, 15.

EXPORTATIONS.

Portuguese East Africa.—Cows, 3.

Northern Rhodesia.—Bulls, 8.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

United Kingdom.—Beef quarters (chilled quality), 1,401; tongues, 7,557 lbs.; livers, 14,881 lbs.; tails, 2,179 lbs.

Northern Rhodesia.—Beef carcases, 229; mutton carcases, 39; pork carcases, 4; veal carcases, 2; offal, 6,327 lbs.

Belgian Congo.—Beef carcases, 129; pork carcases, 80; offal, 188 lbs.

Meat Products from Liebig's Factory.

Union of South Africa.—Corned beef, 384,840 lbs.; sausages, 83,187 lbs.; beef and vegetable rations, 18,480 lbs.; lunch rolls, 550 lbs.; beef and ham rolls, 1,131 lbs.; tongues, 534 lbs.; meat paste, 59 lbs.; beef fat, 60,460 lbs.; hams, 426 lbs.

Northern Rhodesia.—Meat meal, 2,000 lbs.; bone meal, 4,000 lbs.

Bechuanaland Protectorate.—Corned beef, 312 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-40.

Monthly Report No. 100. March, 1941.

Red Locust (*Nomadacris septemfasciata*, Serv.).—The only reports of locusts referring to the month of March which have so far been received deal with a campaign against hoppers in the Chilimanzi district, where some 270 bands have been destroyed.

The presence of numerous additional bands was reported up to the 27th in that district.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

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Editorial

Notes and Comments

Rhodesia Best Beef.

From September 1st, 1941, it is intended to institute a new grade of chilled beef for export to be known as "Rhodesia's Best."

For this grade the Cold Storage Commission will pay 45s. per 100 lbs. dressed weight delivered at the Works, Bulawayo. This price is guaranteed for a period of five years.

Bullocks to make this grade must have not more than six permanent incisor teeth up, be of good beef conformation, be well finished inside and out and weigh not less than 550 lbs. cold dressed weight.

In order to make this weight at 6 teeth, say 3½ years, the young stock will have to be fed during the winter and the bullocks finished off on a good fattening ration, but the price of 45s. per 100 lbs. dressed weight should allow ample scope for both the feeder and the breeder to make a good profit on the production of this type of beef.

The response to the preliminary announcement in regard to this grade made by the Minister at the Farmers' Day at Matopos in April last, has so far been very encouraging. If the farmers support this scheme, as it now appears they will do, there is bound to be a general improvement in the cattle industry of this Colony which will place Rhodesia on a better basis to compete on the overseas market with other sources of supply when this war is over.

Any farmers who are in doubt as to the type of cattle which it will be profitable to feed for this new grade should get in touch with the Department of Agriculture as soon as possible so that their efforts will be in the right direction and any chances of future disappointment be lessened.

Australian Tobacco.

The Journal of the Department of Agriculture of Western Australia for March contains a review of tobacco experiments in that State for the season 1939-40. Tobacco research in Australia is extensively subsidised by the Commonwealth Government and Western Australia has recently had its grant increased.

It is rather interesting to note that the fields selected for the experiments had first to be fenced with rabbit proof fencing. The areas were typical: the soil is not described in detail, but is described generally as being on moist flats. The soil characteristics vary and it has been found that this variability affects the growth and quality of the tobacco to a marked extent.

The fertilisers applied were put on in very heavy dressings as compared with Rhodesian conditions, although the percentage composition of the fertiliser is not stated. Dressings of 500 lbs. and 1,000 lbs. per acre were given, and it is interesting to note that no significant difference in either total yields or values could be detected between the two fertiliser levels.

The minor elements, zinc, copper, manganese, magnesium, and boron were tested, but statistical analysis showed that none of them influenced total yields or values. With regard to all these results it should be pointed out that they refer to a single year: the conclusions may be modified by subsequent work.

Of the varieties planted Kelley gave the highest yield, but the greatest values per acre were given by Yellow Mammoth and Bonanza. The results emphasise how misleading total yield may be as a criterion of varietal suitability, unless leaf value or quality is also taken into account.

The outstanding feature of the cultivation experiment was the appearance of the hilled plots. The hilled rows stood out from the rest of the plots owing to the very dark green colour of their foliage. The effect of hilling was to retard ripening of the leaf in the early planted plots. Late planting with hilling gave the very high total yield of 2,077 lbs. of cured leaf per acre.

In spacing trials spacings were 18 inches, 30 inches and 42 inches. The leaf in the 18 inches spacing was smaller and thinner than on the wider spacings, that in the 42 inches tending to be large and distinctly coarse. Ripening was later on the wide spaced plots. There appeared to be no doubt that the finer leaf obtained from the closer spacing was the type most in demand by the manufacturers.

American Fertilisers.

The value of materials used in the manufacture of fertilisers in the United States in 1937 was $132,000,000. The processed materials which had a wholesale value of $170,000,000 were sold to the farmer for $220,000,000. In that year, although it had only one-sixteenth of the population of the world, the United States used one-fifth of the world's production of 44,000,000 tons of manufactured fertiliser. The three main fertiliser ingredients were nitrogen, phosphorus and potassium, although in many cases the minor elements—zinc, copper, manganese, iron and boron—were incorporated in fertiliser mixtures in small amount. Foreign trade in fertiliser is of considerable importance to America, and is likely to be more so as most of the fertiliser supplies used in the British Empire will come from American sources.

Sources of nitrogen, since the introduction of atmospheric fixation, are inexhaustible, but in any case the provision of nitrogen is the least difficult of fertiliser problems. With regard to phosphate, the United States has the largest deposits of phosphate rock in the world, estimated as sufficient to satisfy American domestic needs for two thousand years. Many of these sources are quite untapped.

The leading phosphate fertiliser in importance and value is superphosphate, which is made by mixing finely ground

phophate rock with sulphuric acid. Double or triple superphosphate containing up to 50 per cent. available P_2O_5, is made by treating finely ground phosphate rock with liquid phosphoric acid.

A significant advance in recent years has been the absorption of free ammonia by superphosphates and double superphosphates. Either ammonia gas or liquid ammonia is admitted to a closed rotating drum containing the superphosphate; the heat of the reaction, together with the movement of the drum produces a very desirable granular product with excellent physical characteristics.

Potash, which formerly came largely from Germany and Alsace, does occur in America in large quantities, particularly in New Mexico, where there are extensive deposits of soluble salts. In addition there are almost inexhaustible reserves of water-insoluble potash minerals. The present production capacity is estimated as more than 400,000 tons of potash annually. Doubtless this could be greatly increased.

Communial Latrines.

An article by G. G. S. J. Hadlow in the Nyasaland Agricultural Quarterly Journal on latrines for natives should be of interest. The provision of adequate latrines in compounds or near grading sheds is a necessary health precaution which too often is not observed. Too often no facilities whatever are provided.

The usual and the most satisfactory method adopted is the digging of a deep narrow trench with suitable covered accommodation, but there are several precautions which should be observed. In the first place the pit must be dark. Flies will not descend into darkness and contamination from this source is therefore avoided. The accommodation must be such that soiling does not take place round the edges of the apertures. Pathogenic organisms, including *B. coli* and *B. typhosus* may be present and may be carried by flies into kitchens and houses. No strong disinfectant should be used, as this would destroy the beneficial aerobic bacteria which

turn the excrement into humus. A wash of milk of lime may be used with advantage. Finally, no pit latrine should be within 100 yards of any well, borehole or stream.

Poison Baits for Locusts.

Lea and Nolte have recently published the results of their laboratory experiments in the Union on poison baits for brown and red locusts. The object of the investigations was to test various substitutes for sodium arsenite as the active principle in baits. Sodium arsenite is very toxic and is highly dangerous to man and animals: an equally efficient substitute is very much needed. Fresh grass was supplied to locust hoppers just before the bait was introduced, so that the bait had to be taken in competition with normal food. A sodium arsenite bait was used as a standard. With regard to potential taste improvers, sugar and salt gave inconclusive results, while sodium bicarbonate proved to be definitely repellant.

Twenty-eight non-arsenical compounds were tested, a large proportion being organic. Calcium chloracetate gave very promising results. Unfortunately so far field experiments have not confirmed the encouraging results obtained with the chemical in laboratory experiments.

Jam From Powder.

Empire countries with crops of fruit held up by lack of shipping will be interested in the new storage processes of chemists at Bristol University Research Station.

The work was originally designed to meet the problem of Britain's own surplus fruit, but with the cessation of imports, the results are now available for Empire producers.

Surplus apples are economically stored, with great saving in space, in the form of apple juice and apple treacle. Natural sugar makes this product extremely sweet, and it is a valuable substitute for sugar in all forms of household cooking.

Soft fruit, plums and apples are reduced to a dry fine powder, useful for food processing. Plum powder can be made into jam at any time of the year.

In their work on black currant syrups, the experts have found that, after a long period of storage, there was present, in some cases, double the amount of Vitamin C (a preventative against scurvy) as in fresh citrus juices. The shortage of Vitamin A has also drawn attention to the need for using all surplus carrots, and a powder is now being extracted commercially in plant normally used for the spray drying of milk.

Witchweed Farm.

The costings of the Witchweed Demonstration Farm at Glendale which it was hoped to publish this month have been unavoidably held up. They will appear in next month's issue of the Journal.

Veld Fires.

A good deal of nonsense has appeared recently in the Press about veld fires, and the relationship of plant and soil. While it is good policy to keep down the burning of the veld, many of the evils listed by local writers do not exist and there are occasions when burning may have beneficial effects. Recent work in the Union has proved conclusively that under certain conditions burning the veld keeps down undesirable types of grass. Further, it destroys vermin.

Such statements as the one that minerals are destroyed and lost are, of course, quite untrue. Minerals present in the vegetation are returned as oxides or carbonates and may help slightly to overcome acidity. Under moist conditions such as are frequent in many high areas of the Eastern District the loss of minerals is much greater where no burning occurs. The continuous acid decomposition of the organic matter has leached away practically all the bases in the soil, which is left exceedingly acid and infertile.

The two respects in which burning is undesirable are the destruction of organic matter and the increased liability of

the soil to erosion. The latter is probably the more serious, though it should be remembered that the roots remain and that the roots are quite as powerful an agent in resisting erosion as is the vegetation. Burning partly sterilises the soil and destroys some of the protozoa which prey on the soil bacteria. As against this, large quantities of organic matter, containing nitrogen, are destroyed. While it is probably true that under the hot moist conditions of the Rhodesian summer the bulk of this organic matter would decompose leaving little humus behind, yet its destruction outside the soil upsets the balance of nature and undoubtedly has a deleterious effect on the soil bacteria.

The ideal solution would be the cutting of the grass, in the earlier stages for ensiling or in the later stages for hay or for composting. The danger of increased susceptibility to erosion would not arise, nor the possibility of too great acid decomposition, and the natural vigour of the bacterial population would remain.

Opportunities for agricultural cleanliness are always at hand.

Cleanliness Aids Insect Control.

Rhodesia's Best Beef for World Markets.

Many years ago, Southern Rhodesia took the bold step of encouraging the establishment of a monopoly in the cold storage business. It, however, reserved the power of expropriation, and in due course that power was exercised. The result of the latter action was the constitution of the present Cold Storage Commission; and, whatever doubts may still exist as to the wisdom of this step, the Colony's Government has thus been placed in a strong position in respect of encouragement of quality and promotion of export. The Commission itself appears to be showing excellent results.

The latest development in this connection has been the announcement of a new grade of export beef to be known as "Rhodesia's Best," the price offered for which will be forty-five shillings per 100 lb. dressed weight, all the year round. Cattle offered for this grade must possess no more than six permanent incisor teeth, and however good their quality, this condition will be strictly enforced. Good beef conformation is also an essential requirement, while the animals must be well finished both inside and out. The minimum dressed weight is to be 550 lb. Captain F. E. Harris, Minister of Agriculture and Lands, recently expressed the opinion that the effort needed to comply with these conditions would lead to a general raising of the cattle standard throughout the country. He looks forward "to a return to the good old days of ranching in Southern Rhodesia" when, he maintains, the Colony, if it had not neglected its opportunites, could have gained a place in the international markets. The present scheme is, he says, no overnight affair but a carefully prepared plan, and in a few years it should be possible to produce the right type of cattle in thousands, whereas Imperial grade, the highest hitherto provided for, has recently been attained by less than nine per cent. of the Colony's beef export.

The latter grade, and the other seasonal provisions operating in recent years, will for the present be continued, but the hopes of those concerned in raising the industry to a level at which it can compete on equal terms with that of the Argentine are centred on the new provision and on the better stock raising methods it will encourage. If these hopes are fulfilled the new policy will be more than justified, and there need be no further carping criticism of the earlier step by which the cold storage monopoly was converted into a monopoly controlled by the State.—*The Farmers' Weekly.*

The value of grass silage conserved in the young and succulent stage is not fully appreciated. It is equal to a highly concentrated feed if properly made.—*H. E. Evans, B.Sc.*

Land Tenure on a Rational Basis.

With all our discussion of conservation of the soil and recognition of the land as a national asset, surprisingly little is heard of conditions of land tenure. Yet this is of the essence of man's relation to the soil. No doubt our traditional attitude to a possession which, in former days in South Africa, could be acquired either without cost or very cheaply is largely responsible, and it is not surprising under these circumstances that exotic systems of land tenancy are apt to be regarded with suspicion. Control of a negligent landowner residing on his own property can best be secured by some such measures as have recently been introduced or foreshadowed in both the Union and Southern Rhodesia. There is room, however, for the adoption of other methods where the land is held by tenants, whether the owner be a private individual or the State. When the period of tenancy is short and the risk of selfish exploitation correspondingly great, control is urgently necessary.

Some interest in this aspect of the subject has recently been manifested in Rhodesia. In a thoughtful contribution to the discussion addressed by Mr. R. C. Simmons to a branch meeting of the British Empire Service League, the view was set forth that tenant farming under the English system would be more advantageous to Rhodesian settlers than either purchase outright or hire-purchase. Tenant farming, said the speaker, everywhere involved more or less the same technique, but the British system encouraged the truest type of co-operation between tenant and landlord. In Africa there was a complete absence of such co-operation and an almost complete absence of protection for either party. "There are two kinds of people who require control, bad landlords and bad tenants." A Rhodesian tenant's expenditure on stumping, contouring and building could often not be recovered for ten or fifteen years, and, if the tenancy happened to be earlier terminated by circumstances, the residue of the value went, under present conditions, as a free gift to the landlord. The bad tenant, on the other hand, took care "to scrape the

meat off the bone of the farm," and before he moved on the property might be irretrievably ruined. These anomalies must be eliminated, and Mr. Simmons put up a good *prima facie* case for employing the British system as a remedy.

In its general principles that system is fairly widely understood. Its first essential is that the land shall be maintained in good heart and the property returned at the end of the lease period in as fertile and prosperous condition as when first taken over. Recent social and other changes in Great Britain have made it necessary to embody these principles in Acts of Parliament, so that, as pointed out by Mr. Simmons, if one of the parties to a leasing agreement finds that he has been induced to sign an unfair or improper contract he can now have the latter annulled, the tenancy being carried on thereafter in terms of the law. The relevant legislation provides for control of farming methods to prevent impoverishment of the land, compensation to a tenant for residual fertility and for improvements, protection of the landlord in respect of rent and wilful damage to land and buildings, proper maintenance of buildings and improvements, revision of rents in relation to the farm's earning capacity and to changing conditions, and various similar points of possible dispute. Under some such system, it is suggested, new settlers in South Africa would find it possible to take up land with far less capital behind them than is now thought necessary, "because in many instances the landlord, whether Government or individual, would put up some of the necessary capital in the first place instead of having to pay it all out at the end." As a consequence, a far larger field of desirable immigrants would become available, methods of farming would tend to improve, and there would be both increased co-operation and increased production. "In support of that opinion, let me remind you that it is under this system of tenant farming that the fertility of the soil in England has been maintained for 250 or 300 years. It is under this system that our great breeds of cattle and horses have been evolved and perfected, and under this system that the great body of British yeoman farmers have attained to the honourable and dignified position in the community which they hold to-day." The South African system has certainly less to show.—*The Farmers' Weekly.*

An Improved Implement for use in Compost-making.

By J. D. SCOTT, in *Farming in South Africa.*

In the making of compost at the Estcourt and Tabamhlope stations, all dry stock are fed in kraals during the winter to afford them maximum protection against cold. A fresh layer of bedding is added to the kraals each week or whenever required until, by the end of the winter, a mixture of grass, dung and urine to a depth of a couple of feet is obtained. This is not touched during the winter as temperatures are too low and there is not enough moisture for much bacterial action.

At the end of winter the cattle return to the veld and, after the bedding in the kraals has been wetted thoroughly by rain, it is built up into heaps about 4 feet 6 inches high varying in width from 12 to 18 feet and in length from 25 to 60 feet. The removal of the material from the floor of the kraal has always been an expensive process. Turning by means of a plough has resulted in continual packing in front of the plough, and a dam scoop has always jumped. As a result the material has had to be removed by hand labour with forks and wheelbarrows which is slow and expensive.

This season an improvement to a dam scoop was tried with excellent results. Four iron bands 2 inches wide and ½ inch thick, sharpened to a point, were riveted under a dam scoop so that the two middle ones projected about 11¾ inches and the two outer ones 10 inches in front of the scoop, being just clear of the inside of the draw-bar. In addition to the rivets, the front edge of the scoop was welded to the bars so that there was no chance of material working between the bars and the scoop.

These sharpened bars penetrated the mixture on the kraal floor easily and it was possible for two boys to remove all the material, with two oxen drawing the dam scoop. As the

passage of the oxen over a heap would have consolidated it too much, the compost material was dumped outside the kraal where two other boys packed it into the heaps.

This improved implement has cut down the cost of compost-making at Estcourt enormously. Two boys with two big oxen in this scoop took the compost material out of the kraal at the rate of just under 19 tons per day (1 cu. yd. at 70 per cent. moisture weighs approximately $\frac{1}{2}$ ton) and, with two boys packing it into heaps, it was possible to build a stack 25 ft. x 18 ft. x $4\frac{1}{2}$ ft. high in two days.

The cost of effecting these improvements to the scoop (at the present high price of iron) is only a matter of about £2 10s. and this amount is easily saved in labour within the first few days. The bands riveted underneath act as shoes, taking all the wear and thus adding considerably to the life of the scoop.

Cleanliness Aids Insect Control.

Water-logging of Irrigated Lands and Remedial Measures.

By R. KAHAWITA, Irrigation Department.

(In *The Tropical Agriculturist*.)

Water-logging and consequent increase of alkali salts in soils is a condition caused either by a rise of the subsoil water table or by inadequate draining of surface water or both. In most of the major irrigation schemes in Ceylon, drainage of asweddumized* lands is left to the resources and understanding of the proprietor or his tenants. Annually large tracts are being alienated to poor peasants who are given limited aid by Government to establish farms according to their understanding. The peasant, in his eagerness to derive an income from the new possessions, with the minimum of labour within the shortest time, seldom gives any thought to drainage, nor does he prepare the lands according to any predetermined plan to take irrigation water without surface waste. Knowing that new clearings are fertile and the yield is good he soon learns that, unless he has an abundant supply of water, he will miss his opportunity. Irrigation is not only his insurance against failure of crops but also his chance to gather a bumper harvest from a new clearing. Thus he feels that the more water he can apply to the land the more certain is he of his bumper harvest. Such misguided enthusiasm results in over-irrigation and finally spells disaster to crop production under irrigation. In the long run, these practices are attendant with dangers which will prove a menace to profitable agriculture. These dangers are water-logging, spread of aquatic plant pests, and increase of alkali salts in the soil. If these are not perceived early they may result in complete abandonment of large tracts or in heavy expenditure in attempting to overcome them.

*"Asweddumizing" means cultivation of paddy fields by puddling.

A study of soils that precedes all land development schemes may indicate its suitability for agricultural purposes both in texture and in chemical constituents. It may have all the desired qualities of a good soil. But with irrigation a change in these conditions must be expected. And this change may be caused by the method of applying irrigation water, or by the physical features of the land or by both. Hence the observations made at the time of the soil survey cannot be considered final and permanent, unless such methods as are necessary to conserve and rehabilitate the soil are adopted when the land is brought under cultivation. It is always well to study beforehand how a soil in a particular area will react to irrigation. Though it may be found that the depth, physical texture, and chemical constituents are favourable with the subsoil free from an excess of alkali salts, for crop raising, one must not forget that these conditions were established under natural influences. One could not say that these would continue to be so under altered conditions. Before a land is exploited for agriculture it is often under heavy jungle giving it impenetrable shade; it has a periodical dry and wet season; it receives a fairly regular rainfall during the monsoons which has carved out a natural drainage system to deal with the surface run-off. When the cultivator starts his operations for crop raising he denudes the land of its jungle and exposes it to the direct rays of the sun; he constructs ridges to hold water and channels to deliver it; he levels and cultivates the soil; and he applies water year in year out. These are conditions quite different from what they were at the time of the soil survey, and if nature is what it is, there should take place radical changes in the soil under the new conditions. Such changes in the soil may be accelerated with poor subsoils, the presence of an impervious hard-pan close to the surface, lack of an effective drainage system and, last but not the least, continuous irrigation.

Under this erratic method of irrigation, or what is called over-irrigation, the first change to expect is a variation of the subsoil water table. It may rise very close to the root regions, and with improper land preparation, it may even rise to the surface at depressions and low-lying areas which will be lost for crop production. This is what is known as water-logging.

Such an artificial raising of the water table, specially in lands devoid of shade, usually aggravates the alkali condition of the soil which will, in course of time, render it entirely unsuitable for crops. This may happen under irrigation even in areas that had not a trace of alkali salts before. Its early appearance may be observed to a marked degree in low-lying areas. The reason for this and the occurrence of alkali salts in soils free from them before irrigation is that, with the continuous application of water, salts are leached out from higher to the lower lands, by seepage from irrigation channels, and by flushing of lands above due to excessive irrigation. This subsoil flow from higher to the lower regions often gathers large quantities of soluble materials which may get concentrated in low-lying and improperly-drained areas. As time goes on, under these conditions such areas may be rendered hopelessly barren. Another factor, often overlooked by irrigators, is that lands higher up in a water-shed are more porous than those lower down owing to heavy soil erosion under natural conditions. A light porous soil results in an excessive loss of irrigation water by deep percolation—which cannot be entirely avoided. If this fact is not borne in mind when issuing water to the lands lower down, over-irrigation is bound to occur with all its dangers. It is not always necessary for the water table to rise within the root regions to cause injury to plants. Owing to capillary attraction, water from the lower crust of soil is drawn to the surface and there evaporated leaving behind it all the harmful salts which had been dissolved in it. The quantities so left in the soil may not be in sufficient concentrations to cause immediate injury to crops. But this upward and downward movement of subsoil water results in the ultimate presence of salts in the effective soil strata. If this is followed by a prolonged dry season the appearance of salts on the surface soil in the form of afflorescence is not rare. This is a common occurrence in arid or semi-arid regions. It must be remembered that irrigation is essential only in such regions for crop production and one of the main characteristics of soils in arid areas is the presence of sodium salts. This is what causes alkalinity in soils, and irrigation causes this characteristic to vary to the detriment of plant life. The salts which occur most commonly in a natural state in soils are (1) carbonates, bicarbonates,

sulphates, and chlorides of sodium, (2) carbonates, sulphates, and chlorides of magnesium, (3) carbonates, sulphates, and chlorides of calcium. Of these salts the most injurious to plant life is sodium carbonate. Though it may not be present in the soil in large accumulations at the commencement of a project there is a chance of its increasing under irrigation by a base exchange with other soluble salts. Also this danger may be present indirectly in the irrigation water if it contains large quantities of calcium carbonate in solution. According to Evershed, the limit of tolerance of vegetation to different alkali salts in the soil is roughly as follows:—

	Per cent.		Per cent.
(1) Sodium carbonate	0.1	to	0.15
(2) Sodium chloride	0.2	to	0.3
(3) Sodium sulphate .	0.4	to	0.6

If these percentages are increased owing to any external causes or causes inherent in the soil, lands become unprofitable for agricultural purposes. Therefore every precaution should be taken to keep these figures down. This only emphasises the need for careful investigation of the soil behaviour before an irrigation project is undertaken. Also it is useful to study what changes may take place in the soil and ground water under irrigation. In summarising, a soil may said to be rendered alkali owing to the following causes:—

(1) water-logging and blocking of natural drainages;

(2) want of sufficient rain to leach out any soluble salts present in the soil;

(3) excessive evaporation with high temperature;

(4) want of sufficient surface and subsoil drainage;

(5) over-irrigation under condition (4).

It should be clear now why special attention should be paid to the correct preparation of lands before irrigation water is turned on to it. In poorly-prepared lands there will be excessive wastage necessitating over-irrigation. This surplus water and waste will collect in depressions and low-lying areas with inadequate drainage facilities. These are the first steps

towards water-logging often of large tracts. Once these conditions have been definitely established the growth of aquatic plant-pests such as Bulrush (*Typha angustata*) and rushes (*Cyperus laevigatus*) follows and this may even gradually spread on to good arable lands. With water-logging, increase of alkali in the surrounding lands is a matter of time.

One should expect to encounter these dangers in the dry zone much more than in the wet zone for the following reasons: In the wet zone, on account of the even distribution of rainfall over the year the natural drainage will have established itself to deal with a perennial flow. Under these circumstances there will be little chance of over-irrigation (if irrigation is necessary at all) and even if it occurs it has very little bearing on the subsoil water table. There will be no significant variations in its level. On the other hand rains are periodical in the dry zone, lasting for about four months at a time. Under these conditions the formation of drainage lines will not be so well defined. Consequently, a good deal of the run-off will collect in depressions and furrows of a rugged terrain. A rise of the water-table is inevitable. During the rest of the year, drought conditions with extremely high temperatures and low humidity exist, resulting in heavy evaporation of soil moisture from the surface. A fall in the water-table follows. With this the surplus water collected in depressions, etc., disappears. Whenever an irrigation system is established in such an area without proper drainage ground-water rises, thus upsetting the balance maintained previously under natural conditions. A fluctuation of the water-table occurs which causes the drawing up of soluble salts to the root regions by capillary action—danger No. 1. As the ground-water approaches the surface deeper plant roots get surrounded with water containing a high percentage of mineral salts, assimilation of which is disastrous to plants. Apart from this, roots do not spread in soils where the moisture content is persistently above field capacity. This limits the feeding area of roots with permanent injury to plant—water-logging—danger No. 2. (Field capacity may be defined as the maximum moisture content to which a soil can be wetted under action of gravity in the field.)

When these points are considered the importance of efficient drainage in irrigation schemes cannot be overlooked. Partial abandonment of once fertile lands owing to bad drainage is not rare. Drainage of agricultural lands is as closely linked with it as irrigation. And it is impossible, in any irrigation project, to predict the adequacy of natural drainage of the area embodied within it. In this country where a survey of the subsoil water-table or observation of its behaviour under irrigation is considered to be of secondary importance in the preparation of a project, the question of artificial drainage to supplement the natural system must be studied with the channel layout. The effect of bad drainage on plant life will not be perceived during the early life of a project. The explanation of this is that, though the soil in the lower regions of a water-shed may be quite porous, underlaid with light soil and subsoil water far below the surface, yet with the introduction of irrigation and heavy cultivation weathering of soil particles and decay of organic matter will take place with a consequent increase in clay, humus, and organic contents of soil. The tendency of these changes in the soil is to change its permeability which in turn affects subsoil flow. Then excess application of water—an evil to which cultivators are often addicted to in new clearings—together with periodical rains will often render the drainage conditions inadequate and inefficient to deal with the increased water under new conditions. This means that a process of soil deterioration will set in and gradually a new regime will be established in the same way as one was established before irrigation was started. Unless the natural conditions are unusually favourable, water-logging is inevitable in continuously-irrigated lands. In the first instance it will appear in the low-lying areas and as time goes on it will spread to higher regions also.

There are few irrigation systems where natural drainage should not be supplemented by artificial drainage, and the expansion of an irrigation system may ultimately require a complete drainage system. When much attention is not paid to proper land development, the necessity for effective drainage will be felt in a considerably short time. A complete drainage system is not going to overcome water-logging nor the alkalinity of soil entirely. Preparation of lands too

must be done in such a way as to facilitate easy drainage when required. Sporadic clearing, ridging, and levelling and the non-observance of any approved plan or method can be considered as factors that accelerate the process of deterioration. Unscientifically prepared lands consume more water than those prepared according to a recognised method. The surplus water taken by the former must find at outlet and, if no drainage facilities are provided, unfavourable soil conditions will be established.

Methods of preventing water-logging.—The first step to be taken in the prevention of water-logging is to discourage waste of irrigation water. It can be done by correct "asweddumizing" with substantial ridges following contours against "fall of land." In partly-developed lands every effort should be made to keep waste water from flowing into the undeveloped areas as surface run-off. If it cannot be avoided then temporary drains must be cut to drain them or early steps taken to cultivate them. In preparing lands the method of applying water to each field depending on its configuration must be settled first and should precede all other operations. And into this method waste-water drains must be incorporated which should be capable of draining into a field channel lower down; if this is impracticable, into a natural drainage line. Surface waste should never be allowed to find its own outlet.

Depressions and pockets that are always found in large tracts must be filled up in the process of levelling. If this is too expensive then they should be converted into receptacles for waste water linked with a natural drainage line by a drain connecting with an effective out-fall. This is very necessary to control its water level according to requirements. Below every block of fields, however small they may be, a waste drain must be provided. Any water flowing into this from its fields above can be directed into a field channel lower down for redistribution. Such a procedure will reduce wastage to a minimum.

Over-irrigation should be discouraged. It could be done by adopting a system of rotational issues, *i.e.*, each block of fields should receive water for 3 or 4 days in the week only. Such a method of issues will help to drain any surplus water

in the soil. Also it is a good practice to rest tracts of fields periodically during the dry season. This is a method practised by small cultivators under village tanks; though they may not know the scientific significance of it, yet they follow it regularly more or less by instinct.

To help in the correct functioning of and guidance in the above methods there must be laid down a main system of drainage in the scheme which must be cut and maintained with the same efficiency and in the same condition as irrigation channels. Apart from natural *drains* there must be ditches to receive waste or surplus water from main channels, distributaries and field channels. Such channels may be either obvious drainage lines, cleared, graded, and maintained in good order, or natural water-courses, or a series of d pressions used as small collecting ponds but linked to a natural stream so that their water level may be controlled. Where artificial channels are required they should be located between two parallel watersheds and led into the main drainage line. Such improvements are always necessary to supplement the natural drainage of an irrigation project. It is on the efficiency of the drainage system that the preservation of the soil conditions depends and not so much on the irrigation system. Irrigation is required only to help the plant to wrest its food from the soil.

The local practice of putting in two crops of the same kind twice a year under intensive irrigation without rehabilitating the soil by the application of some kind of manure must also be discouraged. It is not only bad agriculture but also uneconomic expenditure of productive labour which if directed into other channels may give a better yield. If the natural factors are such that rotational crops cannot be raised in the area, then at least rotational resting of the fields must be adopted. In all cases this must be in the dry season. It must be remembered that of the water applied to a field only a fraction is used up in plant transpiration and evaporation compared to the amount absorbed by the soil. This water must be provided with an outlet so that by its prolonged "stay" it may not affect the soil condition.

In the foregoing pages drainage of surface flow has been dealt with. The next problem is to deal with subsoil flow.

Before any particular method is decided upon, a thorough knowledge of the soil profile of the affected area must be had as the subsoil flow is dependent on the substratum. If this is not pervious, water will collect dangerously too close to the feeding area of roots on the impervious soil and finally may form into a "secondary water table." On the other hand if the soil has a porous substratum within a reasonable depth the percolated water will pass this and finally flow beyond the reach of the roots. If the substratum is composed of sand or gravel fairly deep (of which the capillary power is low) there is no chance of the soil becoming alkali by this process. Soil profiles of this formation are easy to drain and reclaim. Seldom will these be subjected to water-logging or turn alkali. Light soils form a natural subsoil drain and also act as a cut-off preventing the soluble salts from coming up by capillary action. All the troubles arise when the substratum is impervious within an effective depth of about 3 to 4 feet. Such lands are difficult to drain and the necessity to provide an efficient system of drainage, if the area is to receive irrigation, cannot be over-emphasised. Generally speaking the subsoil water-table may be disturbed by the following causes (*a*) percolation from irrigation works and over-irrigated fields, (*b*) rainfall, (*c*) impervious subsoil formations, (*d*) perennial irrigation. Rain by itself is not harmful but with the other causes will alter the regime established under natural conditions.

Subsoil flow too is dealt with by a system of drains, open or covered. Of necessity these drains must be sufficiently deep to keep the required depth of soil free from excess of water. It will be found that these drains are required much deeper than those excavated for surface drainage. There is no hard and fast rule whereby the depth could be fixed. This depends entirely on the individual characteristics of the area to be drained. However, the following points must be considered in deciding on the depth of drains: (*a*) soil formation, (*b*) depth to which injurious salts are present in the soil and their movement with irrigation, (*c*) method and type of irrigation to be adopted, (*d*) types and nature of crops to be grown, (*e*) possibility of clear out-falls.

The need for covered drains depends on the cost of land to be reclaimed, cheapness of materials required for their construction, comparative costs of maintenance of open drains and covered drains, and finally the purpose for which the reclaimed land will be used.

In this article I do not propose to give the constructional details of various types of drains but I hope to do so in a subsequent article.

Lands already water-logged can be made arable by the provision of an effective system of drainage, both surface and sub-soil, as explained above. In a very short time paddy could be grown in lands so claimed even if the soil is not entirely free from salts which may have been formed with water-logging. According to Tamahane, of the Department of Agriculture, Bombay, "Rice is almost the only crop which has sufficient resisting power against salts. Rice requires a clay soil and a large amount of water which dilutes the salts to a considerable extent, thus helping the successful growth of rice in such lands."

Reclamation of alkali lands for crop production is very expensive, often beyond the resources of a local peasant. Methods of reclamation may be grouped into three classes (*a*) physical, (*b*) removal, (*c*) chemical. Under (*a*) where salt has appeared on heavy clay soils it could be removed by "washing the surface" by frequent flooding and then deep cultivation so as to bring the subsoil to the surface to be mixed up with the top soil. This will render the original heavy soil more workable and will improve its permeability. As time goes on surface salts will be dissolved and leached out.

Another method is to give the soil an application of lime and heavy doses of farmyard manure followed by intensive cultivation. Dosage depends on the quality of the soil to be treated. The principle underlying this method is that farmyard manure and lime helps to convert the sodium salts into sodium bicarbonate which is easily leachable and can be drained off. Large areas of heavy clay soils in Hungary have been reclaimed by this method.

A third method—which is more or less designed to preserve soil condition—is to prevent moisture evaporation

from surface soils. Evaporation concentrates the soluble salt contents and this is further increased by the replacement of moisture from the subsoil by capillarity. This moisture often brings up with it soluble salts which accumulate on the surface. It could be prevented by shading, mulching or hoeing of the soil. This method is especially successful in orchards where, apart from preventing the deterioration of soil, it helps to conserve the moisture for the crop.

Under (*b*), leaching of the salts into the subsoil and then draining it off is the most common practice. This is done by dividing the area into suitable checks by means of earth ridges, filling the checks with water and then allowing it to stand so that the water percolates to the subsoil. In its downward movement the salts will be dissolved and taken to the subsoil from where it can be removed by deep drains or below the limit of capillarity. This method to be successful the following conditions must be obtained:—(1) A certain degree of permeability, (2) adequate supply of water, (3) water table below limit of capillarity.

A second method is to cut a system of drains so as to lower the subsoil water below the root regions and thus effectively drain the soil together with soluble salts in it. It is not always possible to restore soils to its original state by draining. However, it may improve with cultivation. If the injury to the soil had been caused by sodium salts (sodiumization) reclamation is difficult because, after a certain limit, the presence of sodium salts make the soil impervious and retards movement of water so that the salts cannot be removed entirely. In fact, based on this characteristic of sodium soils, a method has been evolved in India to stop seepage from irrigation channels—known as the sodium carbonate treatment.

If it is further desired to reduce this limiting salt content (0.4 to 0.57 per cent.), heavy doses of farmyard manure should be given at the rate of about 10 tons per acre. The theory is that farmyard manure liberates free carbon-dioxide in the soil which combines with sodium carbonate to form sodium bicarbonate which is easily leachable. Then if the soil is flooded the sodium salt can be washed into the drains. According to Dr. Mackenzie Taylor, of Punjab, if paddy is

cultivated on soils so treated the soil further improves owing to the action of carbon-dioxide, liberated from the paddy roots, on sodium carbonate which is converted into leachable bicarbonate.

In the chemical treatment of alkali soils the use of the following materials have been experimented upon with varying results: gypsum, bauxite decomposed with sulphuric acid, sulphur, hydrochloric acid, and acetic acid. These processes are expensive, and for us in Ceylon they are only of academical interest. Therefore it is proposed not to discuss them here.

In conclusion it may be mentioned that alkalinity in soils is the worst enemy of agriculture. And unless early measures are taken either to prevent accumulation of salts where it has appeared in small quantities or where it is likely to appear in soils free from it, reclamation later on will prove extremely expensive and difficult. It is an "enemy of agriculture" which can be easily defeated by adopting simple tactics if its presence or its possible appearance is noticed early. It must be remembered that drainage helps the cultivator to get better crops which is the dominant factor contributing towards his prosperity and well being.

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Veterinary Notes.

DIPPING OF CATTLE.

By P. D. Huston, M.R.C.V.S.

We are now coming to the season of the year when dipping ceases to be compulsory for the greater part of Southern Rhodesia. The months in which compulsory dipping is enforced are January, February, March, April, May, November and December, and the fact that cattle owners on a very large scale only dip because it is compulsory and not with the idea of cleaning their veld and consequently keeping their cattle clean is manifest by the number who do not dip at all during the winter months.

The evidence of this neglect of dipping during the winter is the large increase in the number of ticks seen round the eyes, in the ears and under the tails of the cattle during the months of January, February and sometimes March, also the increase in the number of cases of redwater and gallsickness, which are both tick transmitted diseases.

Farmers fail to realise the disaster this infestation would mean if an outbreak of East Coast Fever occurred on their farm. It may be asked why the infestation occurs in these three months, when dipping has already been commenced and the explanation is as follows:—

During the cold months tick life is not active and consequently the cattle owner does not think it is necessary to dip his cattle, but although not active it is by no means dormant and numbers of adult ticks get on the cattle, become engorged, then fall off and lay eggs. When it is considered that each of these adult ticks can lay several thousands of eggs (the number varies according to the species), it is easily seen how quickly the veld may become infested; ticks engorging on game and other farm animals also helps to swell this infestation.

When the first moist heat arrives about the end of September, these eggs commence to hatch out into the first stage of tick life known as "The Larva," these are minute ticks visible to the naked eye only on a glass or in a tube, but are quite invisible on the beast itself. These larvae climb up on the tall grass and await a host, which is found in the grazing cattle, to which they become attached, usually in the ears, they commence to engorge and after engorgement, fall off on the ground again where they moult. The period taken for this moult depends on the weather, it being quicker in warm moist weather than in cold. Having completed the moult they come back in the second stage of tick life, namely, "The Nymph." Before engorgement the nymph is about as big as the head of a large pin and consequently would be practically invisible on an animal. The nymph similar to the larva climbs up the grass to await a host, and its favourite place of attachment is also in the ears and around the eyes.

When the nymph is fully engorged it falls off in a similar manner to the larva and moults to become the adult, which again carries out the same procedure, and these adults are what the farmers refer to as the ear and eye ticks seen in January and February.

The process of each moult under favourable conditions may be put down as anything from four to six weeks, but bad weather conditions can make the period longer, so it is easily seen how the infestation occurs in these months.

The life history of the tick described above is that of the brown tick, which is known as a three host tick, this means that it falls off its host for each moult, the period spent on the animal at each visitation is from four to six days, and from this it will be seen that if seven day dipping is carried out it is possible for a brown tick to become attached, engorge and fall off between the dipping intervals, and this is why farmers complain of the difficulty of killing the ear and eye ticks (as they describe them). It is also the reason why short interval dipping is enforced in outbreaks of East Coast Fever.

It has been proved that seven day dipping will eradicate the brown tick, but this can only be done by continuous dipping over a period of several years, the length of time being governed by the state of tick infestation of the veld.

Larval and nymphal ticks are more easily killed than the adults, consequently dipping and hand-dressing of the ears and eyes in October and November would go a long way to prevent infestation in January and February.

With regard to the blue tick, this is a one host tick, all three moults taking place on the same animal and the period of attachment is from 21 to 28 days, so if seven day dipping is enforced each blue tick would be subjected to three or four emersions whilst on the animal.

The act of dipping is stated by a few cattle owners to be detrimental to their stock during the winter months, the principal thing being loss of condition; but if dipping is carried out reasonably such as not dipping on very cold or wet days, not keeping the cattle too long at the tank and thereby cutting short their grazing time, the ill effects are greatly counter-balanced by the advantages. A few of which are:—(1) No poverty due to gross tick infestation. (2) Decrease in number of cases of screw-worm. (3) No loss of ears due to abscesses from tick infestation with the consequent trouble of treating the abscesses and finally the most important of all, the prevention and eradication of tick-born diseases, namely, East Coast Fever, gallsickness, redwater. Dairymen complain that they have a falling off in milk of anything from 5 to 10% on the day after dipping, which percentage is only made up gradually to the third day.

I quote the following figures taken from the records of a dairy herd for 48 weeks of the year 1940, they are shown in the following order. The amount of milk given at the 1st and 2nd milkings after dipping for each of 48 days, then the 3rd and 4th for the same period and so on.

1st and 2nd milking	8,534
3rd and 4th milking	8,593
5th and 6th milking	8,563
7th and 8th milking	8,635
9th and 10th milking	8,635
11th and 12th milking	8,614
13th and 14th milking	8,635

From these figures it will be seen that the average of the last eight milkings is 8,629.75 and at that the year's production would be 60,408.25.

The difference between the milk yield at the 1st and 2nd milkings after dipping, and the average of the 7th and 8th, 9th and 10th, 11th and 12th, and 13th and 14th milkings is 95.75, the difference between the 3rd and 4th milkings and the same average is 36.75 and the 5th and 6th is 66.75, that is a total loss of 199.25 gallons in an output of 60,408.25, or .33%, *i.e.*, a $\frac{1}{3}$ of a gallon in every 100. In 1939 the percentage loss was .408%.

The herd in question is a very well bred Friesland herd and dipping is carried out at seven day intervals throughout the year, except when unfavourable weather conditions do not permit.

It will be seen from the above figures that the loss in milk production as the result of dipping practically throughout the year was negligable.

Dipping may prove detrimental under the following conditions:—

(*a*) When it is carried out in a haphazard and careless manner.

(*b*) When discrimination is not used with regard to dipping in wet or very cold weather.

(*c*) When attention is not paid to keeping the solution in the tank at the proper strength.

(*d*) When it is carried out at irregular intervals.

(*e*) When the solution in the tank is allowed to become very dirty.

Under these conditions the cattle are never allowed to get used to the effects of dipping and consequently a detrimental effect may be noticed.

Rhodesian Milk Records.

SEMI-OFFICIAL. COMPLETED LACTATIONS.

Name of Cow.	Breed	Milk in lbs.	B. Fat in llbs.	Average % B Fat.	No. of Days.	Name and Address of Owner.
Baby	G Friesland	9038.20	314.16	3 48	300	J A. Baxter, Glen Norah, P.O. Box 1040, Salisbury.
Beans	G Friesland	6611.40	275 10	4.16	300	
Blossom	G. Friesland	14482.70	613.56	4.24	300	
Bud II.	G. Friesland	12150 00	445.76	3 67	300	
Clacupar Penelope	P.B. Friesland	8741 40	329 71	3.77	300	
Lesman	G Friesland	7574 70	332 17	4.38	300	
Mada	G. Friesland	10234.80	417.75	4 08	300	
Romyn	G. Friesland	7529.70	296 68	3.94	251	
Skami	G Friesland	7869 10	322 86	4 10	300	
Susie	G. Friesland	8544.30	359 31	4 25	242	
Trench	G. Friesland	6009.30	270.10	4 49	300	
No J.8	G Friesland	5572.20	215.51	3 87	257	A. L Bickle, P O Box 595, Bulawayo
No J 12	G Friesland	9152 10	252.15	2 76	284	
No. J 13	G. Friesland	8615 20	305 23	3.54	300	
No. J.17	G. Friesland	6797 30	205 81	3.03	264	
No. J.19	G Friesland	8880 50	269 38	3.03	299	
No. J.25	G Friesland	6294.10	249.91	3 97	246	
No. J.25	G. Friesland	6436.30	233 86	3 63	265	
No. J 26	G. Friesland	7521.10	245 94	3.27	300	
No. J.29	G. Friesland	8228 10	261.24	3 17	264	
No. J.30	G. Friesland	7202.30	216 38	3 00	240	
No. J 31	G. Friesland	7825 00	260 73	3 33	300	
No. J.36	G. Friesland	6778 20	225 50	3 33	30[illegible]	
No. J.37	G. Friesland	6354 10	227 03	3 57	286	
No. J.40	G. Friesland	6927 20	210 40	3.04	295	
No. J.40	G. Friesland	7635.30	278 26	3 64	300	
No. J.46	G Friesland	5644 60	207 31	3 67	258	
No. J 46	G. Friesland	5864.60	207 78	3 54	242	
No. J.47	G. Friesland	7931.70	293.26	3 70	300	
No. J.48	G Friesland	6557.40	272 62	4 16	300	
No. J.49	G. Friesland	7333 60	238 94	3 26	300	
No. J.55	G. Friesland	6447 40	211 85	3 29	300	
No. J.58	G. Friesland	6336.00	220.77	3 48	300	
No. 10	G Friesland	7835 40	244.14	3 12	298	
No 30	G. Friesland	8090.40	243 13	3.01	300	
No. 55	G. Friesland	5113 00	211 39	4 13	257	
No. 60	G. Friesland	7727 90	280 84	3 63	300	
No. 61	G. Friesland	6113 10	203 03	3 32	225	
No. 62	G. Friesland	5848 70	217 41	3 72	241	
No. 64	G Friesland	6619 10	215.87	3 26	236	

Bluffhill Audrey Charleston	P.B Friesland	8492 60	263.66	3.15	300	Bluffhill Dairy, P.O. Box 346, Salisbury.
Richard's Pearl	P.B Friesland	12023 40	419 07	3 48	300	
Charleston Sneeker	P B. Friesland	8063.10	306.02	3.80	300	
Cup	G. Friesland	7953.30	290.95	3 66	287	
Longone	G Friesland	7963 30	297.05	3 73	300	
Palmtree Jean B. 3	App Friesland	7234 00	227 02	3 14	300	
Palmtree Martha	App. Friesland	10939.30	430 53	3.94	300	
Palmtree Susie	G. Friesland	7412 30	273 84	3 69	300	
No. 53	G Friesland	6052 70	249.56	4 12	300	
No. 95	G. Friesland	7119 70	291.90	4.10	300	
No. 97	G. Friesland	6604 20	235 50	3.57	300	
No. 83A	G. Friesland	8377.70	274 38	3 28	300	
Bramble	G Friesland	6402 40	231 27	3.61	291	T Cousins, Oaklands, Gwelo
Marie	G Ayrshire	6992.40	346 67	4 96	300	
Merry	G. Friesland	6895 80	244 46	3 55	300	
Molly	G Friesland	7002.20	231 12	3 30	300	
Rita	G Friesland	8164 10	260 37	3.19	288	
Roma	G Friesland	6900 90	259 17	3 76	300	
Rosie II.	G Friesland	5978.10	234 73	3.93	300	
Sister	G Friesland	8036.60	284 63	3.54	294	
No. A.4	G. Friesland	7354 90	245 07	3 33	276	H A Day, Stoneridge, P O. Box 1153, Salisbury
No. A.11	G Friesland	7431 70	265 21	3 57	266	
No. A.28	G Friesland	6105 50	216 33	3.54	300	
No. A.39	G Friesland	7076 80	251 34	3 56	294	
No. A.44	G Friesland	6547 90	206 01	3.15	300	
No. A.47	G. Friesland	6341.60	219 01	3 45	300	
No. A.51	G Friesland	6039 30	217 57	3.60	275	
No. A.88	G Friesland	6269 40	205 28	3 27	300	
No. 56	G Friesland	5896 80	255 15	4 33	300	
No. 60	G Friesland	4686 00	204 28	4 36	300	
No. 62	G Friesland	6715 70	237 35	3.53	300	
No. 95	G Friesland	5850 30	217.66	3.72	300	
Erin Go Bragh's Mary II	P B Friesland	6490 00	223 59	3 45	300	M V Fitzgerald, Chieftain, Iron Mine Hill
No F.G. 33	P B Friesland	6279 00	232.96	3 71	300	
Gilston Placid	G Red Poll	4688 00	204 79	4 37	300	G. N Fleming, Gilston, P O. Box 688, Salisbury.
Plaice	G. Friesland	5864.10	212 24	3 62	293	P. Freeland, Lingfield, Gwelo.
No. 7	G Friesland	7159 30	235 97	3 30	300	
Biddy	G Friesland	7216 60	280.69	3 89	300	Hon H V. Gibbs, Bonisa, Redbank
Gertie	G Friesland	7324 40	259 76	3 55	300	
Peggy	G. Red Poll	6216.10	201.07	3 23	300	
Ladybird	G. Friesland	5401.90	233.68	4 33	300	W. D Haywood, Ordoff Farm, Gatooma.

RHODESIAN MILK RECORDS.

SEMI-OFFICIAL.—(Continued).

Name of Cow.	Breed.	Milk in lbs.	B. Fat in lbs.	Average % B. Fat	No. of Days.	Name and Address of Owner.
Kalulu ..	G. Friesland	7156.10	264.14	3 69	300	D. J. Huddy, Granville, P.O. Box 899, Salisbury
Ounooi II.	G. Friesland	5933 70	214 00	3 61	274	
Pansy	G. Shorthorn	6694.60	242.86	3 63	300	
No. 2 ...	G. Friesland	5627 70	215.12	3 82	280	
No 19 ...	G. Friesland	6555.80	264 73	4.04	300	Sir G M. Huggins, P.O. Box 671, Salisbury.
No. 20	G. Friesland	4639 60	203 87	4 39	284	
Easter ..	G. Friesland	5055 30	212 75	4.21	300	Mrs. M Huxham, Spitzkop, Mazoe.
Selukwe ..	G. Friesland	5614 20	223 03	3 97	300	
Bessie ...	G. Friesland	4664.00	248 07	5.32	300	V. A Lawrence, Knockmaroon, Norton.
Blossom	G. Friesland	7784.50	319 33	4 12	300	
Dewdrop	G. Friesland	6783 50	204.56	3.02	300	
Empress	G. Friesland	8331 50	222 14	2 67	300	
Enterprise	G. Friesland	7857 50	291 58	3.71	300	
Erica	G. Friesland	8548 00	328 62	3.82	300	
Frisky	G. Friesland	7723 50	237 55	3 08	300	
Gipsy	G. Friesland	6842.00	231.90	3 38	287	
Gracie Fields	G Friesland	6764 00	236.68	3.50	300	
Heather	G. Friesland	6572 00	200.74	3.05	300	
No. 221 ...	P B. Friesland	10296 00	275 18	3.64	276	Meikle Bros., Leachdale, Shangani.
No. 332 ..	P.B. Friesland	10408 00	355 54	3.42	300	
No. 170	G Friesland	8004.00	267.60	3 34	300	
No. 181	G Friesland	10848.00	363.22	3.35	300	
Anneced II. ...	P.B Friesland	6978 50	216 47	3.10	300	W. S Mitchell, Springs, Iron Mine Hill.
Anne E. I.	P.B. Friesland	5663.50	213.98	3.78	277	
Annetta I. A. ...	P B. Friesland	8126.50	273.30	3 36	300	
Annetta V.	P.B. Friesland	9208 50	286.90	3 12	300	
Destiny B.	P B. Friesland	6654 50	242 11	3 64	300	
Sheep Run Delina ...	P B. Friesland	6280 00	216 62	3.45	300	
Sheep Run Lily	P.B. Friesland	5476 00	209 55	3.83	260	
Sheep Run Prudence	P.B. Friesland	7088.50	264 74	3 73	300	
Beatrice	G. Friesland	5808 20	215.07	3 70	300	S. Moore, Nyatsime, P.O. Box 999, Salisbury.
Mirabelle	G. Friesland	5913 50	223 62	3.78	300	
Punch	G. Friesland	8570 80	281.48	3.28	300	
Skofmuch II.	G. Friesland	5677 70	240.61	4 24	300	
Lavendar ...	G. Ayrshire	4082.50	200.39	4 91	300	Com E. L. Morant, Marirangwe, Salisbury.
Butterfly	G. Guernsey	4597.00	210 62	4 58	298	G. R. Morris, P.O. Box 1040, Salisbury.
Mabande	G. Guernsey	4517.00	210.33	4 66	278	

Margaret	App. Friesland ..	7602 00	258.05	3 39	300	F. B Morrisby, Sunnyside, Gwelo.
Oldie ...	G. Friesland	6732 00	210.18	3.12	300	
No. 7	G. Friesland	7495.00	286.61	3 82	300	
No. 19	G. Friesland	7661 00	268.83	3.51	300	
No. 61	G. Friesland	6269.00	236.21	3.77	275	
No. 62	G. Friesland	7644 00	262.73	3.44	300	
No. 66	G. Friesland	5646.00	229.54	4 07	300	
No. 75	G. Friesland	7021 00	237.06	3.38	300	
Phoebe	G. Friesland	8759.00	250 88	2 86	300	F. Neill, P O. Box 455, Salisbury.
No. 77	G. Red Poll	4904 90	232 42	4 74	300	Rhodes Matopo Estate, P B. 19K, Bulawayo
No. 93	G. Red Poll	6030 40	224 12	3.72	300	
No. 94	G. Red Poll	6316.00	256 38	4 06	300	
Kopiwe	G. Friesland	6632.10	253 67	3 83	300	W F H Scutt, Maple Leaf, Norton
Mailass	G. Friesland	6550 70	232 93	3.56	292	
Dainty	G Friesland	9012 40	292.43	3 24	300	W Sole, Bauhinia, Glendale
Freda II	G. Friesland	5732.10	205.19	3 58	300	
Sunray	G. Friesland	7807 30	298 56	3 82	300	
No. 23 ..	G Friesland	9593.50	304 29	3 17	300	
Black ..	G Friesland	8455.50	304 62	3 60	261	A Stokes, Safago, Gwelo
Sir Nels Fenella of Shanks	P.B. Guernsey	6856 50	340.44	4.97	300	
Valeries Iona of Delectus	P B. Guernsey	4490 70	232 36	5.18	266	
Valeries Mona of Delectus	P.B. Guenrsey	4990.90	242 72	4 86	290	
No. 85	G. Friesland	10317 50	362 40	3 51	300	
No. 182	G. Friesland	9721 20	324.57	3 34	300	
No. 183	G. Friesland	9359 00	320 45	3.42	300	
No. 186	G. Friesland	8466 80	283.47	3.35	300	
No. 186	G. Friesland	6377.10	211.12	3.31	290	
No. 187	G. Friesland	6675 20	235 75	3 53	264	
No. 193	G. Friesland	6124 40	221.80	3 62	300	
No. 208	G. Friesland	5590 40	200.71	3.59	300	
No. 227	G. Friesland	5493 70	214 65	3 91	284	
No. 228	G. Friesland	5642 40	204.09	3.62	260	
No. 233	G. Friesland	7968.40	301.27	3 78	300	
No. 236	G. Friesland	8367 40	295 39	3 53	300	
No. 237	G. Friesland	7732.50	260.00	3 36	300	
No 248	G. Friesland	6493 00	229 50	3 53	300	
Dorika	G. Friesland	4959 50	207.52	4.18	300	J G Thurlow, Atherstone, Bindura.
Penga	G. Friesland	5406.70	201.75	3.73	300	
No. T.B. 21	G. Red Poll	4880.50	215 17	4 41	265	A. M Tredgold, P.B. 61L., Bulawayo

OFFICIAL.

Colonies Plaats Knierke VII. 11.3.1936	P.B. Friesland	9548.00	337.24	3.53	268	Meikle Bros., Leachdale, Shangani.

Departmental Bulletins.

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N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

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10/31	No. 831.	Revised Notes on Cotton Growing in Southern Rhodesia, by G S. Cameron.
11/31.	No. 836	The Potato, by S. D. Timson, M.C , Dip Agric. (Wye).
12/31	No. 837.	Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L S., Chief, Division of Plant Industry.
6/32	No. 855	Pigeon-hole Method of Stacking Maize, by Division of Plant Industry
8/32.	No 859.	Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.
2/33	No 878	A I V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.
11/34.	No. 936	Witchweed, by S. D Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.
10/35	No 970	Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.
11/35	No 972.	Notes on Witchweed, by S D Timson, M.C., Dip Agric (Wye), Assistant Agriculturist
6/36	No 992	Annual Report of the Agriculturist for the year 1935, by D E. McLoughlin, Agriculturist
8/36	No 997.	Reward Wheat: Report on the Baking Properties and Chemical Analyses, by The Rhodesian Milling and Manufacturing Co., Ltd
4/37.	No 1022	Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc Agric., Ph.D., D.I C., Plant Pathologist, Tobacco Research Station, Trelawney.
9/37.	No. 1044.	Farming Calendar.
10/37.	No. 1046	Green Manuring: Two Important Factors Affecting Success, by S. D. Timson, M C., Assistant Agriculturist, and H. C. Arnold, Manager, The Agricultural Experiment Station.
10/38.	No. 1084	Improved Pastures, by S D Timson, M C., Assistant Agriculturist.
11/38	No. 1089	Witchweed and the Labour Shortage, by S D. Timson, M.C., Assistant Agriculturist.
2/39.	No. 1101	Grass Silage, by H. C. Arnold, Manager, Salisbury Experiment Station
6/39.	No. 1113	Wheat Production in Southern Rhodesia, by D. E. McLoughlin, Agriculturist.
10/39.	No. 1129	Pyrethrum, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.
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12/39.	No. 1136	Compost, by S D. Timson, M.C., Assistant Agriculturist
1/40.	No. 1137.	Compost Notes, by S. D. Timson, M.C., Assistant Agriculturist.
5/40.	No 1153	Field Selection of Seed Maize, by Alan Rattray, Junior Agriculturist.
7/40	No 1158.	Kudzu (*Puerania Thunbergiana*), Cultivation and Propagation, by H. C. Arnold, Manager, Salisbury Experiment Station
10/40.	No. 1164	New Strains of Velvet Beans, by H. C. Arnold, Manager, Agricultural Experiment Station.
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REPORTS ON CROP EXPERIMENTS.

7/27. No. 649. Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager

4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.

7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.

7/30. No. 789. Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.

10/32. No. 864 Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.

6/33. No. 895. Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager

3/34. No. 914. Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric (Wye), Assistant Agriculturist.

9/35. No 965. Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.

5/39 No. 1110. The Management and Utilisation of Natural Pastures, by H C. Arnold, Manager, Salisbury Experiment Station.

4/40. No. 1149. Salisbury Agricultural Experiment Station: Agriculturist's Annual Report on Experiments, Season 1938-1939, by H. C. Arnold, Manager.

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8/26. No. 605. Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc (Eng.), Acting Government Irrigation Engineer.

9/26. No. 615. The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.

5/27. No. 641. The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.

5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.

11/27. No 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

12/28. No. 715. Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.

3/29. No. 728. Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.

4/29. No. 734. Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.

2/30. No. 771. Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.

3/30. No. 774 Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

11/31.	No. 835	Tobacco Culture: Transplanting Operations, by D. D. Brown.
3/32.	No. 846.	Leaf Curl in Tobacco, by Dr. H. H. Storey.
3/33.	No. 885.	Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.
12/36.	No. 1009.	Tobacco Research on the Trelawney Station 1935-36 Season.
4/37.	No. 1025	Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.
8/37.	No. 1039.	Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
1/38.	No. 1054.	Alkalinity of Tobacco Seed-bed Soils, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.
3/38.	No. 1063	A New and Serious Disease of Tobacco in Southern Rhodesia, by G. M Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.
6/38.	No 1072	Report of the Tobacco Research Board for the year ending 31st December, 1937, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board.
5/40.	No. 1154.	Host Plants of the Tobacco Aphis (*Myzus persicae*), by Chas. K. Brain, M.A., D.Sc.
8/40.	No. 1160.	The Tobacco Aphid, by Rupert W. Jack, Chief Entomologist.
12/40.	No. 1167	Turkish Tobacco: Culture and Marketing in Southern Rhodesia, by J. C. Collins, B.Sc., Assistant Tobacco Officer.
12/40.	No. 1168	Field Spraying of Tobacco: Reports from Demonstration Plots, by J. C F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist, Department of Agriculture.

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4/33.	No 887.	The Type of Chiller Steer required for Export, by A. E Romyn, Senior Animal Husbandry Officer.
9/33.	No 903.	The Handling, Preparation and Chilling of Cattle for Export, by C A. Murray, Lecturer in Animal Husbandry.
12/33.	No 907	The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.
1/34.	No 909	Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.
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6/34	No 924.	Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.
1/35.	No. 943	Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.
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6/36.	No. 988	Preparing Cattle for Show, by The Animal Husbandry Division
6/36.	No 989	The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph D , Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric , Experimentalist
4/37	No 1023	Cowpea Molasses Silage for Fattening Steers, by C A Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R H. Fitt, Dipl. Agric , Animal Husbandry Officer, Department of Agriculture, Salisbury
4/37.	N 1024	Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate: A E. Romyn, Chief Animal Husbandry Officer
5/37	No 1029	The Dehorning of Cattle intended for Slaughter and Export, by B A. Myhill, Assistant Chief Veterinary Surgeon
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6/37	No 1032	The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

6/37.	No 1034.	Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C A. Murray and A. E. Romyn.
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2/40	No. 1143	Larger Calf Crops will increase your Profits, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Government Experiment Station, Matopos
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7/34	No 926	Dairy Buildings in Southern Rhodesia. Cow Byre—Type II, by B G Gundry, A I Mech.E.
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6/26.	No 597.	Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B A. (Oxon.), A.I.C.
12/26.	No. 618.	Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S, Director of Veterinary Research.
1/28	No. 666.	Notes from the Veterinary Laboratory: Praemonitus-Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
10/29.	No. 756	Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C V.S, Director of Veterinary Research.
11/29.	No 760	A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.
2/30.	No 772	Notes from the Veterinary Laboratory: Ophthalmia, by Ll. E. W. Bevan, M.R.C.V.S, Director of Veterinary Research
4/31.	No 819.	Measles in Swine, by P. D. Huston, M.R C.V.S.
1/32.	No. 841.	Poisonous or Suspected Poisonous Plants of Southern Rhodesia. Tulip Poisoning of Cattle, by Sydney M Stent, Senior Botanist, and D A Lawrence, B V.Sc, Veterinary Research Officer.
10/32.	No. 866	The Treatment of Intestinal Parasites of Sheep, by J D Coutts, D.V.S., M.R C.V S.
4/33.	No. 886	A Preliminary Note on Contagious Granular Vaginitis in Southern Rhodesia, by D. A. Lawrence, B.V.Sc, Acting Director Veterinary Research
2/40.	No. 1142.	Low Birth-rate of Calves and Calf Mortality, by B. A Myhill, M.R.C.V.S., Chief Veterinary Surgeon.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION

4/27.	No. 640	Levelling for Irrigation, by Dr W S. H. Cleghorn, M.I Mech.E.
11/27.	No. 659	The Hydraulic Ram, revised by P. H Haviland, B.Sc
11/28.	No. 668.	The Water Act, 1927, by C. L Robertson, B.Sc. (Eng.), A.M.I.C.E.
1/28.	No 670	Irrigation Canals, by P. H. Haviland, B Sc. (Eng.).
6/30.	No 786	Low Concrete Dams, by R. Hamilton Roberts, B.Sc (Eng.), Assistant Irrigation Engineer.
2/31.	No 808	The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng), Assistant Irrigation Engineer
3/31.	No 811.	Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
8/32.	No 860.	Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
2/33	No 879	Conditions Governing the Hire of Government Boring Machines.
6/35.	No 956	Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.
9/35.	No 967.	How to use an Engineer's or Farm Level, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

12/35	No 973	Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B Sc. (Eng.), A.M I.C.E.. Irrigation Engineer (Matabeleland).
3/36	No 980	Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc. A.M I C E, Chief Engineer, Irrigation Division, and A. D. Husband, F.I C, Chief Chemist.
8/36	No. 999	Lining an Irrigation Furrow, by R H. Roberts, B.S., A M Inst C.E, Assistant Irrigation Engineer
1/38.	No. 1052	Small Earthen Storage Dams. Part I. By the Irrigation Division.
2/38.	No. 1055.	Small Earthen Storage Dams. Part II. By the Irrigation Division
3/38.	No 1061	Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng), Assistant Irrigation Engineer
7/38.	No. 1077.	A Small Brick Irrigation Furrow, by H. W. H. Wallis, Assistant Irrigation Engineer.
1/39.	No. 1095.	Soil and Water Conservation, by D. Aylen, for the Irrigation Division.
9/39.	No. 1127.	Soil and Water Conservation. Part III. By D.. Aylen and the Irrigation Officers.
11/39.	No. 1130.	The Conditions Governing the Hire of Government Boring Machines, by Major C. E. Goad, M.C., Boring Superintendent.
2/40.	No 1141.	Government Loans and Subsidies, etc., for soil and water conservation, green manuring and artificial fertilisers.
3/40.	No 1144	The Ridger Grader, by D. Aylen and the Irrigation Department.
4/40.	No. 1148.	Contour Planting and Terracing of Orchards, by D. Aylen and the Irrigation Department.
5/40.	No. 1151.	Working Loam Soils for High Yields, by D. Aylen.
6/40.	No. 1155.	Soil and Water Conservation. Part IV. Prevention and Control of Gullies, by D. Aylen and the Irrigation Officers.
10/40.	No 1163.	The Conditions Governing the Hire of Government Boring Machines, by Major C. E Goad, M.C., Boring Superintendent
4/41.	No. 1171.	Erosion and Malaria: Measures which Control both Evils, by G. R Ross, Director of Public Health Laboratories, and D. Aylen, Technical Assistant for Soil Conservation.

FORESTRY.

11/29	No 763	The Utilisation of Wood, by T L Wilkinson, M.Sc., B.Sc.F.
1/30	No 769.	The Utilisation of Wood, by T L Wilkinson, M.Sc., B Sc F.
4/30	No. 778.	The Utilisation of Wood in Southern Rhodesia--Conversion and Disposal of Timber, by T. L. Wilkinson, M Sc, B Sc.F., District Forest Officer
8/30.	No 791.	The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M Sc., B Sc F., District Forest Officer
7/32.	No 857.	Charcoal Burning on the Farm, by R J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.

11/32.	No 869.	Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.
1/33.	No 874.	Tree Planting, by the Division of Forestry.
4/33.	No 888.	The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B Sc, District Forest Officer, Matabeleland.
8/34.	No. 928.	Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J W. Barnes, Manager, Government Forest Nursery, Salisbury.
12/35.	No. 974	Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For (Oxon.), Chief Forest Officer. Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.
10/37.	No. 1045	Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip For. (Oxon.), Conservator of Forests.
6/38.	No. 1073	Pruning of Plantations, by R. H Finlay, B A, Oxon, Division of Forestry.
7/38.	No. 1076	Eighteenth Annual Report of the Division of Forestry for the year 1937, by E. J Kelly Edwards, M A. Dip. For. (Oxon.), Conservator of Forests.
10/38.	No 1085.	The Pot Planting of Eucalypts, by Major G R Wake, Vigila, Umvukwes.
11/38.	No 1087	The Raising and Planting of Trees on the Farm, by E J. Kelly Edwards, M A., Dip. For (Oxon), Conservator of Forests
1/40	No. 1138.	Nineteenth Annual Report Division of Forestry for the year 1938, by E J. Kelly Edwards, M.A, Dip. For (Oxon.), Conservator of Forests
8/40.	No. 1159	Timber Preservation: Butt Treatment, by R H Finlay, District Forest Officer.

HORTICULTURE

4/27	No 637	Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.
8/27	No. 650.	Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.
2/29	No 725.	Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond), A I C.T.A. (Trinidad)
11/31	No 834.	Celery Culture, by G. W. Marshall, Horticulturist.
2/33.	No. 876.	Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.
10/33	No. 905	Notes on African Aloes (Parts 7-10), by H Basil Christian, "Ewanrigg," Arcturus.
5/34.	No. 920	Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist
5/37.	No. 1028.	Tomato Culture in Southern Rhodesia, by G. W Marshall, Horticulturist.
2/39.	No. 1100.	The Rhodesian Home Orchard, by G W. Marshall, Horticulturist.
4/40.	No. 1150.	The Health of Seed Potatoes, degeneration due to virus diseases is the greatest source of loss. Journal of the Ministry of Agriculture, December, 1939.

ENTOMOLOGY AND PLANT PATHOLOGY

2/13.	No.	139.	Termites, or "White Ants," by Rupert W. Jack, F.E.S.
6/15.	No.	214.	Some Household Insects, by R. Lowe Thompson, B.A.
2/21.	No.	385.	The Common Fruit Beetle, by R. W. Jack, F.E.S.
12/24	No.	522	Notes on the Black Citrus Aphis, by C. B. Symes.
8/25.	No.	548.	Insect Pests of Cotton, by C. B. Symes.
9/27.	No.	653.	The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad).
1/28.	No.	665	Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28.	No.	671.	Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.
6/28.	No.	696	Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
11/28.	No.	714.	Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.
3/29	No.	732.	Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
6/29	No.	742	What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29	No.	754	"Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.
6/30.	No.	784	Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
6/30	No.	788.	A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
			A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist. Supplement No. 1.
7/30.	No.	790.	Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.
10/30	No.	796	The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.
11/30.	No.	798	The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
1/31.	No.	804.	Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.
3/32	No.	848.	Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B.Sc. (Lond.)
4/32	No.	850.	Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.
6/32.	No.	856	A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.
9/32.	No.	861	Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.
5/33	No.	892.	The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.
5/33.	No.	893	Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

6/33.	No	894.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.
6/33	No	896.	A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.
7/33.	No.	897.	The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.
8/33.	No.	899.	The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes.
2/34.	No.	911.	Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.
3/34.	No.	913	Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology.
4/34	No	917	The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.
10/34.	No	934	Mycological Notes. Seasonal Notes on Tobacco Diseases 7, Spraying in Seed-beds and Lands, by J. C. F Hopkins, D Sc (Lond.), A I C.T.A., Senior Plant Pathologist.
1/35.	No.	942.	Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C F. Hopkins, D.Sc. (Lond). A.I C T.A., Senior Plant Pathologist.
4/35.	No.	950.	The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist
4/35.	No	951.	Suspected "Streak" Disease of Maize. Notice to Growers, by J. C F. Hopkins, D.Sc. (Lond), A.I C.T.A , Senior Plant Pathologist.
6/35.	No.	957.	Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D Sc. (Lond), A I C.T.A., Senior Plant Pathologist.
8/35.	No.	962.	The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.
10/35.	No	969	The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M Wickens, Ph.D. (Lond.), D I C., Assistant Plant Pathologist.
5/36.	No	986	Annual Report of the Division of Entomology for year ending 31st December, 1135. by Rupert W. Jack, Chief Entomologist
7/37.	No.	1037.	Division of Entomology: Annual Report for year 1936, by R. W. Jack, Chief Entomologist.
8/37.	No	1040.	A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I C.T.A., Senior Plant Pathologist.
10/37	No.	1047.	Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J. C. F. Hopkins, D.Sc. (Lond), A.I.C.T.A., Senior Plant Pathologist.
12/37.	No.	1050	An Unusual Winter Outbreak of Maize Weevil *Calandra oryzae*, L.), by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
2/38.	No.	1059	A Poison Bait for Young Locust Hoppers.

6/38. No. 1074. A Note on a Stem Rot of Sweet Peas, by J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.

7/38. No. 1078. Mycological Notes: Seasonal Notes on Tobacco Diseases. II. Two Destructive Curing Moulds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A. Senior Plant Pathologist.

8/38. No. 1079 Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1937, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist

8/38. No. 1080. Annual Report of the Division of Entomology for the year ended 31st December, 1937, by Rupert W. Jack, Chief Entomologist.

9/38. No. 1082. The Life History of Root Gallworm or Root Knot Eelworm, by M. C. Mossop, M.Sc., Entomologist.

10/38 No 1086. The Spraying of Tobacco Seed-beds and Control of Rosette Disease, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist, and M. C. Mossop, M.Sc, Entomologist.

1/39 No. 1097. Cleanliness Aids Insect Control: Some Examples of Agricultural Hygiene, by M. C. Mossop, M.Sc., Entomologist.

4/39. No. 1108. Three Important Strawberry Diseases, by J. C F. Hopkins, D.Sc. (Lond.), A.I.C.T.A, Senior Plant Pathologist.

8/39. No. 1121. Report of the Division of Entomology for the year ending 31st December, 1938, by J. K. Chorley, Acting Chief Entomologist.

8/39. No. 1122 Report of the Branch of Plant Pathology for the year ending 31st December, 1938, by J. C. F. Hopkins, D Sc (Lond.), A.I.C.T.A., Senior Plant Pathologist.

10/39. No. 1128. Mycological Notes. 12. The Diplodia Danger, by J. C F. Hopkins, D.Sc., A I.C.T.A., Senior Plant Pathologist.

11/39. No 1132. Mycological Notes. 13. The Diplodia Danger, by J. C. F. Hopkins, D Sc., A.I.C.T.A., Senior Plant Pathologist.

12/39. No. 1134 Mycological Notes 14 Seasonal Notes on Plant Diseases, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

3/40. No. 1145. The Bed Bug and a new aid for its control, with special reference to native quarters, by M C Mossop, M.Sc., Entomologist.

5/40. No 1152. Diseases of Fruit, Flowers and Vegetables in Southern Rhodesia. I.—Common Diseases of Apples and their Control, by J C F. Hopkins, D.Sc. (Lond.), A.I.C.T A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.

6/40. No 1156. Mycological Notes. 15—The Tobacco "Kromnek" Virus in Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

9/40. No. 1161. Control of Maize Weevil (Calandra oryzae, L.), by M. C. Mossop, A.F.C., M.Sc., Entomologist.

9/40. No. 1162. Diseases of Fruit, Flowers and Vegetables in Southern Rhodesia. 2—Black Rot Disease of Cabbages and Cauliflowers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T A., Senior Plant Pathologist.

POULTRY.

The following pamphlets can be obtained from the Poultry Officer upon application:—

7/38.	No 1075	The Artificial Incubation, Brooding and Rearing of Chickens, by H. G. Wheeldon, Poultry Officer.
11/38	No. 1090.	A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer.
12/38.	No. 1092.	Feeding and Drinking Appliances for Poultry, by G. H. Cooper, Assistant Poultry Officer
5/39.	No. 1111.	Ducks on the Farm, by H G. Wheeldon, Poultry Officer.
12/39.	No 1135	Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

METEOROLOGICAL.

12/22.	No. 436	The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M I.C.E.
12/24.	No. 524	The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A M.I.C.E.
2/25.	No. 532	The Short Period Forecast and Daily Weather Report, by C L. Robertson, B.Sc., A M.I.C.E.
6/25.	No 542.	Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B Sc., A.M.I.C.E.
10/28	No. 712	The Time, and How to Find It, by N. P Sellick, M.C., B Sc. (Eng.).
10/31	No 832	The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.
2/33	No 877	Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc , Meteorologist.

AGRICULTURAL BUILDINGS

4/26	No. 588.	Concrete on the Farm, by N. P. Sellick, M.C , B Sc (Eng.), Assistant Irrigation Engineer.
8/26	No 605	Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
5/27	No. 644	Tobacco Baling Boxes, by B G. Gundry, Irrigation Branch
11/27.	No 661	Flue-curing Tobacco Barns, 12 ft. x 12 ft x 16ft., by B. G. Gundry.
9/33.	No. 902	Brick-making on the Farm, by A. C. Jennings, Assoc M.Inst.C E
12/33	No. 908.	A Charcoal Safe or Cooler, by B. G. Gundry, A.I Mech.E., Irrigation Division.
5/34	No. 922	Dairy Building in Southern Rhodesia: A Small Farm Dairy, by B G Gundry, A I.Mech.E.
7/34	No 926	Dairy Buildings in Southern Rhodesia Cow Byre--Type II , by B. G. Gundry, A I.Mech E.
10/36	No. 1002	A Simple Farm Gate, contributed by the Division of Forestry
5/37.	No. 1031.	Cattle Bale Grip.
8/37.	No. 1041.	Feeding Pens for Bullocks: the Layout at Estes Park, near Salisbury.
1/39.	No. 1098.	The "Gundry" Tobacco Furnace, by B G Gundry, A.I.Mech E.
12/40.	No. 1169	Piggeries, by B. G. Gundry, A I.Mech.E., and A E. Romyn, Ph.D

CHEMISTRY

12/29.	No. 762	—The Value of Rock Phosphate and "Bone and Super phosphate" as Fertilisers for Maize Production, by A. D. Husband, Chief Chemist.

4/32.	No. 852.	Mixing of Fertilisers: A Guide to Methods of Calculation, by the Division of Chemistry.
1/34.	No. 910.	The Toxicity to Grazing of Grass Sprayed with a Solution of Sodium Arsenite, by A. D. Husband, F.I.C., and J. F. Duguid, M.A., B.Sc.
5/35.	No. 954.	Experiments on the Toxicity to Fowls of Arsenite of Soda and Poisoned Locusts, by J. K. Chorley, F.R.E.S., and R. McChlery, B.A., B.Sc.
4/36.	No. 983.	Annual Report of the Branch of Chemistry for year ending 31st December, 1935, by A. D. Husband, F.I.C., Chief Chemist.
7/37.	No. 1035.	Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.
		MISCELLANEOUS.
4/28.	No. 686.	The Land Bank, Its Functions and How it Operates, by S. Thornton.
4/28.	No. 687.	The Use of Explosives on the Farm, by P. H. Haviland, B.Sc. (Eng.).
9/28.	No. 707.	Wood-Charcoal in Southern Rhodesia, by T. L. Wilkinson, B.Sc., Assistant Forest Officer.
5/31.	No. 820.	The Great Economic Problem in Agriculture—No. 1, by J. R McLoughlin, M.Sc. (Economist), Economic Adviser.
6/31.	No 823.	The Law of Supply and Demand—No. 2, by J. R McLoughlin, M.Sc. (Economics), Economic Adviser.
		Twelve Simple Rules for the Avoidance of Malaria and Blackwater.
		Summary of the Game Laws of Southern Rhodesia.
11/34.	No. 935.	The Weeds and Poisonous Plants of Southern Rhodesia, by Chas. K. Brain, M.A., D Sc., Director of Agriculture. Part I
8/35.	No. 961.	A Home-made Ridger. Contributed by Mr. Douglas Aylen, Somerset, Concession.
1/36.	No. 975.	Fertilizers, Farm Foods, Seeds and Pests Remedies Ordinance, 1914.
2/36.	No. 979.	The Prospects of Black Bass in the Inland Waters of Southern Rhodesia. Specially contributed.
6/36	No. 991.	Silage and Silos.
8/36.	No. 998.	Summary of the Game Laws of Southern Rhodesia.
3/37.	No. 1018.	Veld Fires. The "Forest and Herbage Preservation Act, 1936," by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
3/37.	No. 1021.	Breaking in Young Oxen to the Yoke, by J. B West, Dromoland, P.B Lonely Mine.
7/37.	No. 1038.	Star Bur-weed (*Acanthospermum australe*, O. Kuntze), by Chas. K. Brain, D Sc., Director of Agriculture.
8/37.	No. 1042.	Weeds of Southern Rhodesia. Part II. By Chas. K. Brain, D.Sc., Director of Agriculture.
2/38.	No. 1056.	Notes on the Cashew Nut. By C. K. Brain, Director of Agriculture.
2/38.	No. 1057.	The Preservation of Farm Beacons and how to make use of the Fencing Law
2/38.	No. 1060.	How to make Tobacco-Wash on the Farm, by M. C. Mossop, M Sc., Entomologist, Department of Agriculture.
3/38.	No 1064.	Farm Roads, by Stuart Chandler, Chief Road Engineer
4/38.	No. 1065.	Nitrification in Red Soil in the Salisbury Area, by A. P. Taylor, M A., B Sc , and B. S. Ellis, B.Sc., A.I.C., D.I.C., Agricultural Chemists.

4/38. No. 1067. Grass Mowers, by H. Beynon, from "The Farmer," March 4th, 1938.

4/38. No. 1068. The Control of Veld Fires, by The Division of Forestry.

9/38. No. 1081. Uncontrolled Grass and Forest Fires and their Prevention, by the Rev. Father A. B. Burbridge, S.J.

11/38. No. 1088. How to Instal a Simple and Efficient Hot Water Supply on a Farm, by W. A. Welch, Tantallon Farm, Salisbury.

1/39. No. 1096. Trees and Wild Flowers on the Rhodesian Farm. Part I. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

2/39. No. 1099. Trees and Wild Flowers on the Rhodesian Farm. Part II. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

3/39. No. 1102. Trees and Wild Flowers on the Rhodesian Farm. Part III. By Chas. K. Brain, M.A., D.Sc, Director of Agriculture.

4/39. No. 1103 Scurvy and How to Prevent It. Public Health Pamphlet No. 3.

4/39. No. 1106. Trees and Wild Flowers on the Rhodesian Farm. Part IV. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

4/39. No. 1107. Some Notes on Game Bird Preservation, by W. E. Poles, Esq., on behalf of the Wild Life Protection Society of Southern Rhodesia.

5/39. No. 1109. Summary of the Game Laws of Southern Rhodesia, as at 1st May, 1939.

5/39. No 1112. Trees and Wild Flowers on the Rhodesian Farm. Part V. By Chas K. Brain, M.A., D Sc., Director of Agriculture.

6/39. No. 1114. The Rhodes Inyanga Estate.

6/39. No. 1116. Trees and Wild Flowers on the Rhodesian Farm. Part VI. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

7/39. No. 1118. Grass Fires and Fire-belt Burning, by J. R. Perrins, P.B.S. Ranch, Fort Rixon.

7/39. No. 1119. Trees and Wild Flowers on the Rhodesian Farm. Part VII., by Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

8/39. No. 1123. Trees and Wild Flowers on the Rhodesian Farm. Part VIII. By Chas. K. Brain. M.A., D.Sc., Director of Agriculture.

9/39. No. 1125 Trees and Wild Flowers on the Rhodesian Farm. Part IX. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

9/39. No. 1126. The Course of Prices of Certain Agricultural Products in Salisbury, by the Acting Government Statistician.

12/39. No. 1133. Trees and Wild Flowers on the Rhodesian Farm. Part X. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

1/40. No. 1139. Trees and Wild Flowers on the Rhodesian Farm. Part XI. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

3/40. No 1146. Trees and Wild Flowers on the Rhodesian Farm. Part XII. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

7/40. No. 1157. Some Hints for Cotton Growers, by G. S. Cameron, Empire Cotton Growing Corporation.

11/40. No. 1166. Good Haystacks must Resist Weather Damage: Modern Methods of Stacking, by G. J. Firman, Ganmain.

Southern Rhodesia Veterinary Report.

APRIL, 1941.

DISEASES.

African Coast Fever was diagnosed on the farm "Essex" in the Umtali native district.

TUBERCULIN TEST.

Seventeen bulls, 116 cows, 11 heifers and 3 calves were tested on importation. Two heifers gave positive results, and were destroyed.

MALLEIN TEST.

Four horses were tested with negative results.

IMPORTATIONS.

Union of South Africa.—Bulls, 18; cows and heifers, 132; horses, 2; sheep, 552.

Bechuanaland Protectorate.—Slaughter cattle, 422; sheep, 373; goats, 75.

EXPORTATIONS.

Northern Rhodesia.—Sheep, 100.

Portuguese East Africa.—Slaughter cattle, 59; sheep, 40.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

United Kingdom.—Beef quarters (chilled quality), 8,029; tongues, 13,829 lbs.; livers, 28,415 lbs.; tails, 4,418 lbs.; skirts, 7,650 lbs.; tongue roots, 1,600 lbs.; hearts, 2,338 lbs.

Northern Rhodesia.—Beef carcases, 222; mutton carcases, 48; pork carcases, 4; offal, 8,069 lbs.

Belgian Congo.—Beef carcases, 81; mutton carcases, 80; pork carcases, 80; offal, 464 lbs.

Meat Products from Liebig's Factory, West Nicholson.

Union of South Africa.—Corned Beef, 329,108 lbs.; corned beef hash, 2,250 lbs.; sausages, 396 lbs.; beef and

vegetable rations, 63,000 lbs.; ideal quick lunch, 2,640 lbs.; lunch rolls, 432 lbs.; beef and ham rolls, 360 lbs.; steak, kidney and onion, 1,200 lbs.; meat paste, 146 lbs.; beef fat, 57,500 lbs.; hams, 550 lbs.

Northern Rhodesia.—Bone meal, 30,000 lbs.

Bechuanaland Protectorate.—Bone meal, 2,000 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-41.

Monthly Report No. 101. April, 1941.

Red Locust (*Nomadacris septemfasciata*, Serv.).—The campaign against hoppers came to an end during April, the last report referring to a small band in the Gwelo district during the third week of the month.

Reports received in April, but referring to March, have indicated the presence of hoppers in the districts of Inyanga, Chilimanzi, Gwelo and Wankie. These outbreaks have been dealt with in all inhabited areas. Damage to native crops is reported in two of these districts.

On the 21st April a large winged swarm crossed the border from Portuguese East Africa into the Darwin district flying N.W. On the 23rd a swarm was reported over Chipinga in the southern Melsetter district and other swarms were stated to be present on the international border in that area. On the 29th a large swarm was flying from east to west through the Kandeya Reserve in the Darwin district.

These are all the reports of winged swarms so far received.

Rupert W. Jack,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

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Editorial

Notes and Comments

Soya Beans.

The soya bean has long been known as a crop of great value, not only as a food for man and beast, but also on account of the variety of products which have been prepared from it as a result of scientific research. It has not been grown extensively in this Colony, although it has recently received a stimulus as a result of plant breeding work whereby the undesirable characteristics of the varieties of seed previously available have been overcome. Farmers who are interested in the cultivation of this crop are referred to an article on the subject published in the October, 1940, issue of this Journal and reprinted as Bulletin No. 1165.

It cannot be too strongly emphasised that only recognised varieties of seed which have been proved suitable under local conditions should be planted. In this connection only one of the yellow-seeded varieties—Potchefstroom No. 184—is at present obtainable in commercial quantities in the Colony. Importation of seed from the Union is not advisable as none of the Union varieties tested by the Department has proved entirely suitable. A limited quantity of the following proved selections is available for issue in small parcels to farmers who are prepared to sow them sparsely on good soil to increase the seed supply as rapidly as possible:—Potchefstroom 184, Hernon 268 and Hernon Selections. Applications should be made to the Agriculturist, Department of Agriculture, Salisbury.

As a result of enquiries initiated by the Department of Agriculture the Rhodesian Industries Co., Salisbury, is prepared to offer farmers a minimum price of 16s. per bag of 200 lbs. nett for soya beans. This price is based on utilising the beans for the extraction of oil and disposing the residual cake, as stock food or fertiliser. It is pointed out that this is a minimum price and would be increased should a market of a more profitable nature be found. The Rhodesian Industries Co. will enter into contracts with farmers for the purchase of their crops at the above price.

Tsetse Fly Operations.

Elsewhere in this issue there is a report on the tsetse fly operations in the Colony during 1940. Since that was written an increase in the number of cases of animal trypanosomiasis has occurred on a number of farms on the Eastern Border. To date it would appear that the outbreak will not be as extensive or as severe as that of 1939. Cases of animal trypanosomiasis have recently been diagnosed on the Honde River in the lower Sabi Valley, indicating that *G. morsitans* has invaded the Colony at this point. This invasion was foreseen.

Availability of Phosphates.

A paper on the availability of phosphates was recently read by Mr. Arthur M. Smith at a meeting of the Division of Fertiliser Chemistry, American Chemical Society, Detroit, and reprinted in the *Fertiliser, Feeding Stuffs and Farm Supplies Journal*. The paper was in the main a presentation of the generally accepted information now in published literature and, as such, will be interesting and useful to Rhodesian farmers. The outstanding points are detailed below.

Applied phosphorus, as in superphosphate, rock phosphate, etc., seems to be most readily available in slightly acid soils, but the availability decreases rapidly as the acidity increases and it is very low in alkaline soils. Most of our red soils, which are predominantly slightly acid, are therefore

ideal for the absorption of phosphorus, and even our sandy soils, with a few exceptions, are not too acid for phosphorus absorption purposes. Lime is a deterrent to the availability of rock phosphate but an advantage with soluble phosphates.

In acid soils, di-calcium phosphate (*i.e.*, what we know as citric-soluble phosphate) seems to be slightly more available than mono-calcium phosphate (water-soluble phosphate), and in most slightly acid soils superphosphate appears to have the highest availability; the explanation of this, given by the research workers is the influence of the small quantity of magnesia and sulphur which it contains. Also, the application of soluble phosphates, such as superphosphate, tends to destroy the toxic properties of aluminium.

All research work has demonstrated the effectiveness of a layer of soil between the fertiliser and the seed in reducing plasmolysis and injury from too high soluble salt concentration. It has also shown the importance of a relatively high concentration of phosphates in the soil solution immediately after transferring plants from the plant-bed to the field.

The literature is full of the published results of comparisons of phosphate fertilisers, and on the whole it has been shown that in soils rich in organic matter and with abundance of mineral plant foods the crop response from rock phosphate is profitable, and in some instances equal to that from superphosphate. The comparison, however, on limed soil was very often to the disadvantage of rock.

A comparison between pulverised and granular fertilisers would have been interesting but, unfortunately, the paper simply states: "There are too few comparisons between pulverised and granular phosphate materials and pulverised and granulated complete fertilisers of similar composition."

Star Burweed.

Wide publicity was recently given to the new pest Star Burweed (*Acanthospermum australe*) in the local Press and in the December, 1940, issue of this Journal.

The weed was added to the list of plants named in the schedule of the "Noxious Weed Act, 1926," which includes Burweed, Mexican Poppy, Dodder and Prickly Pear. It now appears that the correct botanical name of upright Burweed is *Acanthospermum hispidum*. There are two species of *Acanthospermum*, one upright in growth, *A. hispidum* (the proclaimed species) and the second, prostrate in habit, *A. australe*.

According to reports received by the Department of Agriculture it is feared that Star Burweed is more widespread in its incidence throughout the Colony than was at first thought. Up to the present, however, the Police have not taken any active steps to call the attention of farmers to the requirements of the Act. Occupiers of land, holders of mining locations and others defined in the Act as "persons responsible" are required to clear or cause to be cleared any noxious weeds occurring on the land in respect of which they are responsible. Any person who fails to comply with a notice received from a weed inspector and any person who obstructs a weed inspector in the exercise of his duty is liable to penalties under the Act.

It is appreciated, however, that if a weed is already widespread in its incidence throughout the Colony, it is hardly practicable in war time to insist on eradication measures.

With a view to obtaining the closest co-operation of all concerned, the Department has requested the views of Farmers' Unions and Associations as to the prevalence of these weeds in their areas and how the question of controlling or preventing their spread can best be achieved under present conditions.

Soviet Agriculture.

It is stated by "Russia To-day" Press Service that the average annual grain crop in the U.S.S.R. for 1937, 1938 and 1939, notwithstanding the severe droughts in the two latter years, amounted to more than 100 million tons, exceeding the 1913 harvest, the best in pre-revolutionary Russia, by one-third. The grain crop in 1940 amounted approximately to 112½ million tons. There are 243,000

collective farms in the Soviet Union, embracing 18,800,000 peasant households, or 94 per cent. of the total number of peasant households in the country. The Soviet Government has handed over the collective farms to their free use in perpetuity 940 million acres of land, which represents an average of 50 acres per household. It is estimated that Soviet agriculture employs more than half a million tractors, nearly 170,000 harvester combines and 200,000 lorries.

The Conversion of Feeding Stuffs to Food for Man.

It has often been advocated that farmers should endeavour to make their grain walk off the farm in the shape of cattle, pigs and poultry. In this connection much interesting information is given in a comprehensive paper by Leitch and Godden entitled "The Efficiency of Farm Animals in the Conversion of Feeding Stuffs to Food for Man" and published by The Imperial Bureau of Animal Nutrition. Amassing data from a large number of experiments and a great variety of sources they have compared the relative efficiencies of animals in producing protein, fat and energy. To do this comparable periods in the life of the animals were chosen. The efficiency of fattening the mature bullock or pig can best be compared with that of the cow during full lactation, while the efficiency of the bullock from birth to slaughter is, for baby beef, more comparable with a complete year in the life of the cow and for the two to three year old bullock with the whole life of the cow. The feed expenditure recorded for pork and bacon pigs covers only the period from weaning to slaughter, but the expense of rearing from birth to weaning would make only an insignificant reduction in efficiency. The efficiency of egg production is on a comparable basis with that of milk production.

Taking all these points into consideration they conclude that the cow producing 6 gallons of milk daily is more efficient in all respects than any of the other animals. Even at the productive level of 4 gallons daily it is superior, except in fat production, where it is excelled by the pig. The hen laying an egg daily competes with it, or equals it in protein production.

Over a year the average 600 gallon cow is excelled in fat production by the pig, but only good hens, laying as many as 200 eggs in the year, equal it in protein production.

For meat production the pig is more efficient in all respects than beef cattle. There is no significant difference between meat and mutton production judged from the fattening period. Poultry produce meat protein more efficiently than either cattle or pigs, but fat much less economically.

This aspect of nutrition is receiving considerable attention in Great Britain to-day, where the aim is to allocate animal feeding stuffs to the classes of livestock that can do most to meet human needs.

THEIR GOOSE IS COOKED.

Bruce and Lucy Bander
Won't hear propaganda;
And so they see pests eating crops
Everywhere they wander.
They don't appreciate that—

Cleanliness Aids Insect Control.

Dawson Scheme for Encouraging Early Maturing of Chillers

This competition will be repeated this year and will include Mashonaland. Entry forms can be obtained from The Secretary, Bulawayo Agricultural Society, P.O. Box 244, Bulawayo. Entries close 15th July, 1941. No entry fee.

Conditions.—14 weaners from owners of 500 or more head; 7 weaners from owners of less than 500 head. Weaners to have been calved in the summer 1939/40.

To be available for branding or ear-tagging by a representative of the Agricultural Department on or about 1st September, 1941. Some exhibitors in the previous competition had taken no action to look after their exhibits in the winter months preceding the date of branding. If on the present occasion the officer undertaking the branding is satisfied that the weaners have obviously been neglected, such weaners will not be branded.

Age of weaners will be determined by absence of any permanent incisors on date of branding on or about 1st September, 1941.

Animals to be ready for final adjudication on 1st September, 1942, or 1st March, 1943, at the premises of the Cold Storage Commission, Bulawayo, and must fall within the requirements for "Rhodesia's Best." The actual date for final adjudication will be announced after the result of the examination of the exhibits which are to come up for judging on the 1st September, 1941.

Exhibitor's selection of 10 or 5 out of each exhibit will be judged.

Entries are invited from Matabeleland and Mashonaland.

Prize money is expected to reach £500 if the number of entries justifies it.

In submitting his competitive scheme to the Bulawayo Agricultural Society Mr. W. B. Dawson wrote:—

"The origin of this competition was firstly to encourage a reduction in the age of chillers hitherto used for export meat, and secondly to aim at interesting agriculturists to include 'feeding' in their activities.

"I developed this scheme for encouraging earlier maturing of chillers with the idea that an animal breaking four to six teeth was a better proposition from the point of view of the buyer overseas than one near breaking six teeth to full mouth. Whether this was an economic proposition from the producer's point of view was a matter which this competition would ultimately disclose.

"In the case of the younger animal, there must be no neglect of winter feeding. In the case of the older animal approaching full mouth the longer span of life does not, in my view, mean a material improvement in age reduction over the practice which has hitherto existed in the production of chillers for export, nor does it make it imperative to 'feed the weaner.' However, this competition is being continued to determine what will ultimately be the overseas buyer's idea of what is 'Rhodesia's Best,' and whether this can be economically produced."

The merits of winter feeding and of feeding weaners have been pointed out on several occasions in this Journal and warrant their application in farm practice. It is therefore hoped that this scheme will commend itself to stockowners throughout the Colony and receive the support it deserves, thus ensuring a large entry for the competition.

In its origins at least, health is the province, not of the doctors, but of the farmers.—*G. T. Wrench, M.D.*

Tsetse Fly Operations.

SHORT SURVEY OF THE OPERATIONS BY DISTRICTS.

By J. K. Chorley, Entomologist.

Extracted from the Annual Report of the Chief Entomologist.

The continued retreat of the tsetse, *G. morsitans*, in the northern areas has considerably lengthened the lines of communication with our base camps, three of which have had to be moved forward during the year in order to ensure effective control of the operations. In the Wankie area the base camp has been transferred 60 miles north to Sibilo Vlei in the Sebungwe district, the main camp in the Doma area has been moved 40 miles north to Tondongwe on the escarpment, while in the Darwin area a new main camp has been established 60 miles north near Bandilombidzi, also on the escarpment. The cost of transporting supplies has increased considerably in all areas, while the cost of meal has also increased owing to the Maize Control Act. Supplies for Muzaza camp in the Sebungwe are obtained from Bulawayo and have to be transported 161 miles by rail and 90 miles by motor lorry. Tondongwe camp is now 92 miles from the railway at Sinoia, and Bandilombidzi 100 miles from Bindura. Over 150 miles of road were cut to open up these advanced camps. Communication with these base camps by heavy motor lorries is impossible during the rains and all supplies for the wet season have to be purchased and transported before the rains commence.

In conformity with the general plan of campaign as laid down, the operations have been pushed forward on four fronts, mainly in the Sebungwe, Urungwe, Lomagundi (Doma) and Darwin areas, and minor adjustments in the line have been made in Lomagundi, S.W. The operations in the Darwin and Doma areas are now entirely confined to the Zambesi Valley, the fly having been pushed north of the escarpment on a front of over 100 miles, extending from Darwin to west of the Angwa River. The general policy pursued is the maintenance of the whole of the country south of the escarpment

free from tsetse and available for either European or native settlement.

The area actually cleared of tsetse remains approximately at the figure given last year, namely, 6,100 sq. miles. It is, in fact, too early to expect results from the new areas included in the operations during the last two years. An appreciable improvement has occurred in the older areas, particularly in the Urungwe, Darwin and Sebungwe districts, where the density of fly has been reduced to vanishing point over fairly extensive areas.

There has been an increase in the number of native cattle running in the previously infested Doma area, where there are now over 2,090 head, while a few head have been estab·lishd at a kraal close to the escarpment. In other areas native cattle are being taken into country recently cleared of tsetse, a notable instance being the introduction of stock to the junction of the Kana and Shangani Rivers in the Bubi district, where there have been no cattle since about 1912. The improvement in the Urungwe district has made available for European settlement a very large area suitable for tobacco and a considerable number of farms have been surveyed. One large block of land has been taken up, the northern position of which actually lies within the danger zone north of the cleansing chamber at Vuti.

The position on the Eastern Border east of Chipinga has greatly improved, only 132 cases of animal trypanosomiasis having occurred compared with over 1,000 last year, and fewer farms were involved. Very extensive felling operations were completed along the most vulnerable stretch and maintenance work carried out ,over the rest of the clearing.

The continued advance of *G. morsitans* towards our border in the lower Sabi Valley necessitated the inception of controlled game elimination operations as a defensive measure.

A total of 15,509 head of game were destroyed for an expenditure of 34,447 rounds of ammunition or 2.2 rounds per head.

A sporadic outbreak of animal trypanosomiasis occurred on the Umtali commonage during July, involving about ten head. Later, during October and November, fourteen cases

were diagnosed on "Valhalla," a border farm, east of the Vumba Mountains. On this farm 26 cases occurred, with twelve deaths. It is presumed that there is a very light infestation of tsetse in Portuguese East Africa, but as there is a considerable population of both European and native owned cattle in the immediate vicinity of the border, stated to be free from trypanosomiasis, the source of the trouble is rather a mystery. It is possible that further outbreaks may not occur, at least for some little time. The species of tsetse involved in these outbreaks is not known.

Darwin.—The distribution of fly has remained unchanged during the year. The area covered by the operations was extended west to the Kadzi River in the Sipolilo district, where they join up with the native hunters controlled from Doma, at the end of the rains. Fly densities are extremely heavy close to the Msengedzi River, game is abundant and the effect of the operations in this new area will not become apparent for some years.

South of the escarpment cattle have now been established at Cheweshe's kraal on the extreme north-west corner of the Kandeya Native Reserve, while a few head have been introduced to the Mavuradona Mission Station below the escarpment, close to the eastern boundary of the Chiswiti Native Reserve. No cases of animal trypanosomiasis have been reported. A new main camp was established on the escarpment sixty miles north of Darwin and several miles of new roads cut to improve communications.

Doma Area.—This area up to the escarpment was cleared of tsetse by 1937, and has remained clear since that year. An extension of the operations north of the escarpment was considered unnecessary and inadvisable until the eastern extension of the Zambesi Valley fly belt in the Darwin district began to recede before the pressure of our operations. By the end of last year the Chiswiti Native Reserve in the Darwin district had been cleared of tsetse and the operations extended to the Utete River. At the end of the rains the main camp was moved from Doma to Tondongwe on the escarpment and the operations pushed north on a broad front below the escarpment from the Angwa River on the west, linking up with the operations in the Darwin district on the east. A

temporary dry season camp was established on the Hunyani River below the escarpment. The operations previously carried out by the Native Department in the Sipolilo area were also pushed forward and taken over by this office.

Density counts have been taken over the whole area, which is heavily stocked with game and in most parts densely infested with fly. The operations cover an area some 15 to 20 miles north of the escarpment, but do not extend as far north as the Portuguese border.

Urungwe.—The great improvement in this area mentioned in last year's report has been reflected in the greatly decreased number of tsetse caught off traffic at Vuti cleansing chamber. In fact, no flies were caught during the second half of the year. The main road to Chirundu is practically clear of fly to the escarpment, though fly persists in some numbers a few miles from the road on the Rekometje River and elsewhere, and is particularly dense near Chipatani. Much of the land cleared of fly, or which in the past was in the danger zone, is very suitable for tobacco, and a number of new farms have already been taken up and many more surveyed. Vuti chamber is actually south of one of the areas taken up, which is temporarily unsafe for cattle, necessitating an extension northward of the area covered by the present operations.

A few cases (7) of trypanosomiasis occurred early in the year on "Coldomo Farm," and among native stock on the Nyaodza River and Chikangwe River, a small stream near the headquarters of the Mleleche River, in all about twenty cases. These outbreaks are sporadic and in no way indicate a deterioration in the position, which in general has improved. A few head of cattle have been established near the middle of the Urungwe Native Reserve, where there have been no cattle since 1931. The area covered by the operations was extended to the Sanyati River in order to accelerate the eradication of fly from the Urungwe Native Reserve, which, in the near future, may be required to accommodate cattle moved from the ground now taken up by European farmers.

The main road below the escarpment to Chirundu is lightly infested with fly, which may increase in density as game returns to the vicinity of the road. Around Chirundu both game and fly appear to be on the increase now that construction work on the road and bridge has ceased.

Lomagundi, S.W.—The distribution of fly in this area has remained unchanged, no tsetse having been seen in the previously cleared areas north of the Umfuli River and east of the Sanyati River. West of the Sanyati River an apparent increase in density was noticed at some pans much favoured by game. These pans remained full of water after the heavy rains of 1938/39 and 1939/40.

During May a sporadic outbreak of trypanosomiasis occurred on Msamgo Farm, about eleven head contracting the disease. It was assumed that fly had been carried to the farm, either by motor cars coming from the Sanyati River or on elephant, which crossed the Umfuli on several occasions from the fly infested Nyhondi area south of the Umfuli River. As a precautionary measure two guards were posted at the old Zumba Fly Station and all traffic examined for the presence of tsetse. These guards were withdrawn in November, no tsetse having been seen. Two elephant bulls were also destroyed in order to keep the herd south of the Umfuli River. No further cases of the disease have been reported since June, and it is unlikely that others will occur, though there may be relapses.

The area covered by the operations was extended to the Umvumvudzi River at the end of the rains.

Gatcoma.—Tsetse still persists in very small numbers on the east bank of the Umniati River below Rob's Drift, particularly on the Nyhondi River, but is on the point of extinction. West of the river a decrease in density was noticed over the area covered by the operations, only odd flies now being seen close to the Umniati River. Some miles further west of the river heavier densities have been recorded close to the Gokwe plateau. A few milch cows have been kept at a mine close to Rob's Drift for several months and so far have not contracted trypanosomiasis, although fly is known to be present within 10 miles of the mine and can be carried to the mine on cars or cyclists. Progress has been slow during the last two years, but in general, satisfactory. A few more natives with their families have settled along the Umniati River, but until the area is completely cleared of fly it will not be possible to re-settle the Sanyati Native Reserve, as the native people desire to take their cattle with them.

Sebungwe (late Gwaai and Shangani Area).—The general distribution of tsetse in this area has remained unchanged, fly still persisting in very small numbers on the Mzola River at Cefula Pan. Two flies only were caught at Cewali Pan, and two or three more at different points north of the Mzola River, but south of the M'kulugusi Forest. With the exception of the Cefula Pan area tsetse has now been eradicated from the whole of the country south of the Mzola River. The M'kulugusi does not carry any permanent fly. One fly was caught at Selembani Camp, south of the Shangani River, in an area where no tsetse have been seen for over four years. It was most probably carried on a train of donkey pack animals coming from the Mzola River.

A new main camp was established at Muzaza Hill, sixty miles north-east of Gwaai Bridge, on the main road to the Victoria Falls. Communication with this camp during the rains is very difficult and the camp has been temporarily closed down, together with most of the advanced shooting posts, for the wet season.

No cases of trypanosomiases have been recorded from the Gwaai River and native cattle are being pushed further down the Snangani River as far west as the junction of the Shangani and Kana Rivers.

Melsetter (Eastern Border).—It is gratifying to be able to report a very considerable improvement in this area as compared with the previous year. The number of suspected cases of trypanosomiasis was 132 with 24 deaths, involving nine farms, compared with over 1,000 cases and 400 deaths during 1939 on thirty-two farms. Eighty-two cases with fifteen deaths occurred on one farm which had over 500 cases during the previous year. The number of cases actually diagnosed by blood smears was 20 compared with 311 in 1939. The extensive programme of widening the border clearing, which was commenced early in 1939, as soon as it was evident that the position was deteriorating, was continued throughout the present year, a large gang of native labourers and two European supervisors being employed. Particular attention was again given to the area lying between the Busi and Cheredza Rivers, the clearing along most of this stretch being about doubled in width on the top of the hills. Regrowth

was slashed back over most of the old clearing. Few working days were lost owing to wet weather, the winter and spring being very dry for the border. A very good burn to suppress regrowth was obtained over most of the clearing.

Two hundred and fifteen traps were erected, placed chiefly in lines running across the main valleys in the border clearing, *i.e.*, those of the Busi, Chibudzana, Inyamadzi and Cheredza Rivers. These traps caught a total of 22 tsetse (14 *G. brevipalpis*, 9 male, 5 female; 8 *G. pallidipes*, 5 male, 3 female). The total number of flies caught either in Rhodesia or close to the clearing, which in many places enters Portuguese Territory, was 306, comprised of 291 *G. brevipalpis* (281 male, 10 female) and 15 *G. pallidipes* (9 male, 6 female). The total number of flies caught inside Southern Rhodesia was 32 (20 *G. brevipalpis*, 17 male and 3 female) and 12 *G. pallidipes* (7 male, 5 female), compared with 11 (7 *G. brevipalpis* and 4 *G. pallidipes*) caught during 1939. These figures, however, are not comparable. The majority of these flies were caught in the Inyamadzi and Cheredza Valleys, particularly in the case of *G. brevipalpis*; *G. pallidipes* was found to be more widespread and has been caught near the top of a range of high hills 1,500 feet above the valley of the Inyamadzi.

Valuable assistance was given by the Portuguese authorities, who provided free labour to clear a broad fireguard along the main line of traps across the Inyamadzi Valley in Portuguese East Africa.

A short period was spent in Portuguese East Africa testing the relative attractions of various traps and screens of different colours.

Sabi Valley.—The continued encroachment of the tsetse *G. morsitans* in Portuguese East Africa towards our border was confirmed by an investigation carried out in July by permission of the Portuguese authorities. On the Honde River *morsitans* was found to be established within 10 miles of the border and all the native cattle in the area had died from trypanosomiasis. On the south bank of the Sabi River at Massengena the fly had continued to spread and cattle were infected some 10 miles south of the river. The position called for immediate defensive action, and controlled shooting

operations under the charge of a European Ranger were commenced in October. Every effort will be made to prevent the destruction of nyala, an antelope which only occurs in this locality in the Colony.

Traffic Control.—As foreshadowed in last year's report, it was found possible to close down the cleansing chamber at Nyamarapara, in the Darwin district, in March. Two stations are still being operated, namely, Vuti Chamber, sixty miles from the Zambesi River, which deals with traffic proceeding towards Sinoia, and Chirundu, where traffic proceeding north into Northern Rhodesia is examined. If the position in the Urungwe area is maintained it will be possible to close down the chamber at Vuti during the coming year and transfer this chamber to Chirundu.

The following traffic was examined:—

(*a*) *Vuti Chamber.*—640 motor cars bringing 14 fly (9 male, 5 female); 2,660 pedestrians and 408 cyclists (899 parties) bringing 11 fly (8 male, 3 female); total, 25 fly (17 male, 8 female).

Compared with 1932 (106); 1933 (94); 1934 (178); 1935 (454); 1936 (519); 1937 (241); 1938 (162); 1939 (62).

No flies have been caught at this chamber since July.

(*b*) *Chirundu.*— 680 cars, bringing 74 flies; 1,202 pedestrians, 368 cyclists (722 parties), bringing 286 flies; total 360 flies (sex unknown).

Compared with 46 during four months of 1939.

(*c*) *Nyamarapara Path (Darwin).*—231 pedestrians, 8 cyclists (68 parties), bringing no fly.

Compared with 1932 (112); 1933 (97); 1934 (85); 1935 (161); 1936 (403); 1937 (40); 1938 (38); 1939 (14).

This station was closed in February, the last fly being caught in July, 1939.

Tsetse Fly Research.—Study has been continued of differences in the physiological condition of *G. morsitans* adults attracted to (1) man and (2) motor vehicles. In this connection large numbers of flies caught on the different attractants have been analysed for weight of fat content and of non-fatty solids at Salisbury, and the females have been dissected to ascertain their condition in respect to pregnancy. The results obtained to date from work on these lines have not been fully consistent and the matter needs further study.

Costings of Farm Operations.

ON THE WITCHWEED DEMONSTRATION FARM, AUCHENDINNY, SEASON 1939-40.

By S. D. Timson, Asst. Agriculturist, and G. L. Black, Dip. Agric. (Durham), Manager.

History.—As a result of representations made to the Secretary, Department of Agriculture and Lands, by a combined meeting of the Concession (Mazoe) and (Mazoe) Glendale Farmers' Associations which was held on 1st July, 1938, a conference of delegates representing the above Associations, and also the Shamva and Poti Valley Associations, met the Secretary, Department of Agriculture, and the Agriculturists at the offices of the Department. The object of the conference was to discuss the advisability of the opening by the Department of a number of demonstration plots in the Mazoe Valley to illustrate the methods of controlling witchweed, which have been advised by the Department of Agriculture.

The conference finally recommended that it was very desirable that a farm in the Mazoe Valley, which was known to be severely infested with the parasite, should be acquired by the Government, and that the methods of control recommended by the Department of Agriculture should be demonstrated thereon, with the ultimate object of bringing the farm back to a state where the economic production of maize and other crops is possible.

The farm Auchendinny, situated three miles north-west of Whitecliffe Siding, between Concession and Glendale, was recommended by several of the delegates as being very suitable for the purpose in view, since it was well known by them, and by many other farmers, to be very severely infested with the parasite. One of these gentlemen had himself farmed half the land for several years and was therefore well acquainted with the extent of the infestation.

The recommendation by the conference was accepted by the Government and the farm Auchendinny was taken over in January, 1939, with the above-mentioned object in view

as the primary aim, and with the further object of obtaining information concerning the cost of the recommended control measures, and of improving on them where possible.

Owing to the late date of taking over it was not possible to plant any crops until November, 1939.

The Farm.—The farm is 1,058 acres in extent, and of this approximately 400 acres is arable. Approximately half this area had been abandoned by the tenants in 1937 owing to the severity of the infestation by witchweed, and the remainder yielded poor crops of maize for the same reason.

Of this 400 acres of arable land, some 90 acres consists of wet heavy black soil, which is unsuitable for cultivation except in dry seasons, owing to its becoming rapidly waterlogged after the seasonal rains commence.

Approximately 98 acres is contact soil, of which some 33 acres is a light red contact type. The remainder of the arable land is heavy red loam soil. This arable area is much divided up (into 14 fields), and this, and the fact that only two of these fields contain no wet black soil, makes it difficult and uneconomical to work.

Of the heavy black soil one field of 20 acres was sown to *Paspalum dilatatum* to provide grazing free from witchweed, and a further 33 acres was allowed to revert naturally to grass. Twenty acres of heavy red and contact soil was sown to Rhodes grass to supply clean grazing. Fifteen acres of red contact soil was laid down to Rhodesian Sudan grass to provide seed for trap-cropping.

Cropping System.—Approximately 312 acres of land were cropped under the following rotation during the year under review.

(1) Trap crops and green manure crops reaped for compost.

(2) Maize for grain and wintersome and horse gram for silage. Receives 200 lbs. per acre of rock and super.

(3) Maize plus compost and 150 lbs. of rock and super per acre.

(4) Legume hay crops—ground nuts—sunflowers—sunnhemp for seed.

This rotation has since been changed to a 3-course rotation in order to simplify the trap-cropping programme.

System of Costing.—Since the Manager of the farm is the only European staff employed it was clearly imperative to adopt the simplest possible system of recording the costs of the various farm operations.

The operating expenses, or what may be called the farmer's out-of-pocket expenses, are the only costs which are recorded in the costings given below, that is, the cost of labour and rations, fertilisers, seeds and stores such as bags, twine, seed disinfectants, etc.

The expenditure on labour for each field, or crop, or farm operation, is recorded by means of a labour allocation book, wherein the labour employed on any particular field or job is recorded daily. In a loose-leaf file one sheet is allocated to each job or field or section of a field, and the expenditure on labour is tranferred to this file periodically, and therein the expenditure on seeds, transport, fertilisers and sundry stores, etc., is also entered against each field or crop.

The cost of labour which has been lost owing to the interfernce of rain has been charged against the job on which that labour was employed at the time, but it has been found in the year under review that this is not satisfactory, and now all "labour time lost" due to interference by weather is separately recorded.

The cost of artificial fertilisers is charged over two years to the fields to which they are applied; 70 per cent. of the cost in the first year and 30 per cent. in the second year. The only exception to this is where fertiliser has been applied to trap-crops which have been ploughed under, or reaped for hay. In this case the cost of the fertiliser where the crop is ploughed in is charged on the above basis to the two succeeding crops, and interest on the money invested in the fertiliser at the rate of 6 per cent. for twelve months, is charged against the trap crop. Where the last trap crop, and the sunnhemp sown with it, have been mown for hay, 50 per cent. of the cost of the fertiliser is charged to the trap crop and 50 per cent. to the following crop.

With regard to compost, it is considered that the effect of dressings of 5 tons (10 cubic yards) or less per acre is exhausted in two years, and the cost of making and spreading the compost on the land is charged to the field to which it is applied over two years; 70 per cent. of the cost in the first year and 30 per cent. in the second year. For dressings of compost above 5 tons per acre and up to 10 tons (20 cubic yards) per acre, the cost of making and spreading it is charged to the field over three years; 60 per cent. in the first year, 25 per cent. in the second year, and 15 per cent. in the third year.

Upkeep and depreciation on machinery and implements is not included in the costings, since the Manager's time was too fully occupied to allow of exact account being kept of all the items of upkeep. Since all the machinery was new the cost of maintenance was much below the average farm expenditure on this item.

No charge is made for ox labour, but it may be mentioned that on the Government Farm at Gwebi, where it was possible to keep exact tally of all the costs of this item, the cost was found to be 5d. per acre of land under maize. This included a charge of 6d. per head per month for grazing.

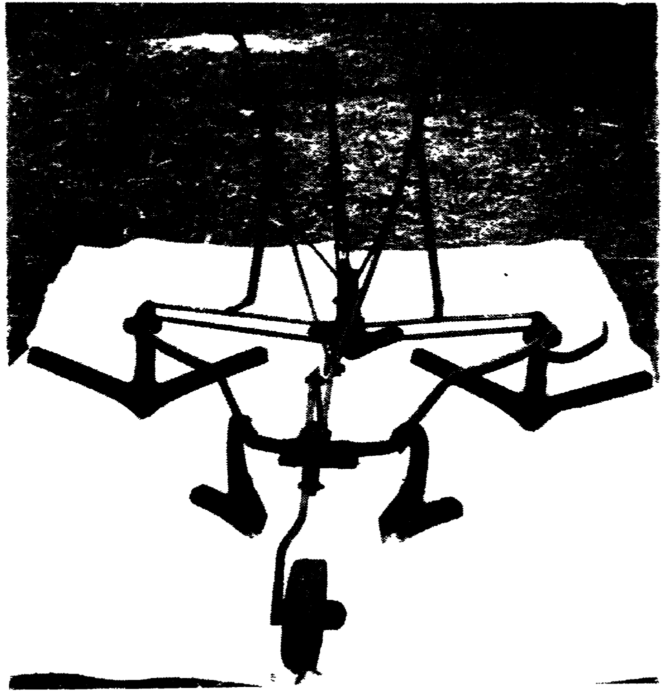
Labour.—The average complement of labour maintained during the year was 25 natives. No recruited labour has been employed and the average wage paid was 15s. 9d. per month at the opening of the year, and this rose to 16s. 7d. per month at the end of the year. The average cost of the food ration per native was approximately 3d. per day. Quinine is included in the ration during the critical malaria period, and would appear to have effected a considerable saving in labour costs owing to the almost complete absence of fever cases, as compared with reports received from other farms in the Mazoe Valley.

The average number of natives available during the period November to April for hand-cultivation was 15; varying from 14 to 18.

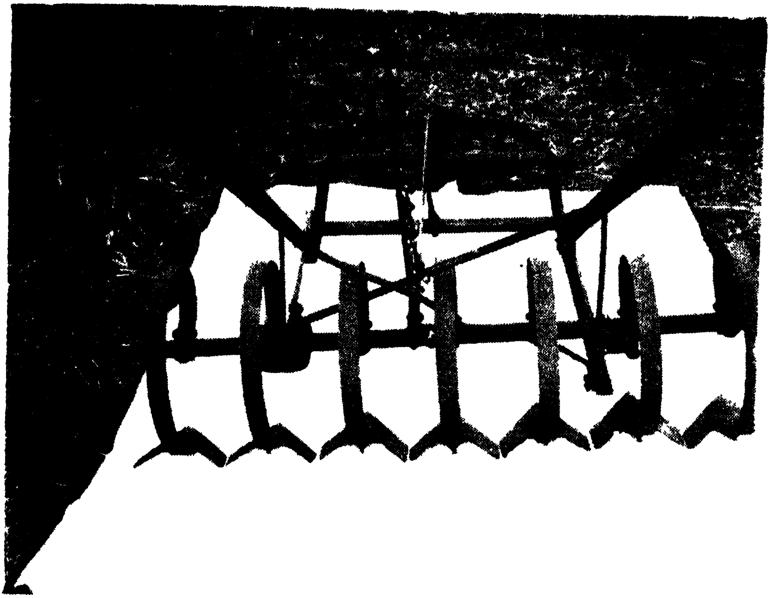
Three spans of oxen were employed on the farm.

General.—There has been up to date an almost complete absence of accurate information concerning the cost of

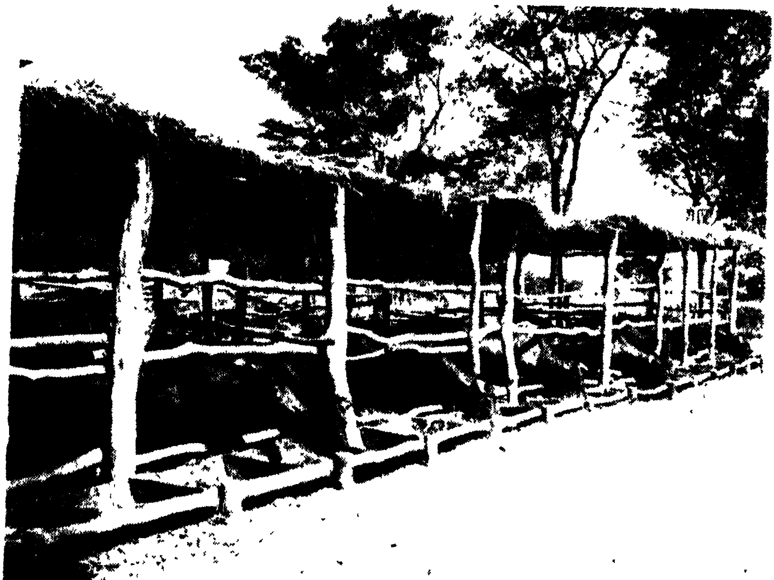
No. 1.—The saw-tooth weeder designed on the farm for withweed control in 6 feet rows. The angle of the blade is adjustable. Small skids at each side regulate the depth of working which is very shallow, so that the soil flows over the top of the blade. One ox in head-harness pulls it.



No. 2.—A 5-tine expanding cultivator adapted to cultivate 6 feet rows. Suitable for killing witchweed. One ox in head-harness pulls it with ease



No 3.—A section of a spring-tooth harrow adapted for cultivating 6 fee rows. Suitable for witchweed and other weeds. One ox in head-harnes will pull it, but two are better



No. 4.—Cattle fattening pens on Auchendinny The troughs were made from half oil drums

eradication or control of witchweed and it is hoped that the costings of this work, as carried out on Auchendinny, will supply this want and prove of value to farmers and to all those who serve them in an advisory capacity. The costs of this work as revealed in the statements below will necessarily be considerably higher than those on the average farm in the maize belt, since it is doubtful if any farm in that area is more severely infested with the parasite than Auchendinny, and it is considered that very few are as severely infested. Moreover, owing to the extremely awkward shape and multiplicity of the small fields and the inclusion of heavy black soil in most of them, the costs of most field operations for these reasons alone must be unduly high.

The practicability of trap-cropping twice, and also three times in one season, has again* been demonstrated under some of the most difficult conditions likely to be met with, and the statement of the costs of this operation given below reveal that the operating expenses are not excessive, and where the last trap crop mixed with sunnhemp is mown for hay, the sowing and killing of three trap crops in one season can be carried out at a profit to the farmer. In this case there was a profit of 1s. 0½d. per acre. Naturally, the farmer must be in a position to economically utilise the hay crop produced by this system of control, and this emphasises the necessity for the judicious combination of livestock with crop farming. With this most desirable end in view, cattle are fattened for sale, a small flock of sheep is being built up, and a breeding herd of bacon pigs is being developed on the farm.

It is one of the basic aims of the policy in the management of Auchendinny that it shall be run on as nearly commercial lines as is possible, so that the interested farmer may know that what is done there can be equally well or better done on his own farm and at the same or lower cost. For this reason tractor power is not utilised, although it would naturally make trap-cropping a much simpler job, albeit more expensive, and for the same reason no money is wasted on "spit and polish" on the farm.

It is not considered that the costs shown in the statements given here are either the highest or the lowest that can be

*It was first demonstrated on the farm of Mr. A. W. Lawrie, Howick Vale.

expected on any well organised farm. They simply show what the costs have been for the current year on this farm. It is hoped, however, that with more experience the costs of the witchweed control operations on Auchendinny will be very appreciably reduced, and indeed the costs of the second season's operations are already showing that this is the case. Trap-cropping should cost appreciably less (or show a greater profit) on the average farm, since fertiliser would not normally be applied to the trap crop.

The excessively high costs of planting should be particularly noted, since they demonstrate what is not perhaps sufficiently realised by those observers who are not actually farming themselves, namely, that in a difficult planting season heavy loss may be incurred by the farmer due to the interference of rain with farm work. It may be mentioned in this connection that during December of the season under review only one day was free from rain, and the total rainfall for the month was 12.72 inches.

The seasonal rainfall should be considered in connection with the practicability and cost of the various operations, particularly in relation to trap-cropping. It was as shown below during the season 1939-40:—

Month.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar	Total.
Rainfall, inches	0.61	9.38	12.72	3.18	13.04	8.42	47.35

Another factor which raised the costs of production, especially on fiield No. 11, was the very dirty state of the fields. Besides the witchweed all fields were badly infested with weeds such as Rapoko grass, Kokoma or Guinea Fowl grass and Nut grass.

All the land under maize, some 197 acres, was found to be severely infested with witchweed. Some indication of the severity of the infestation is given by the counts made of individual plants of witchweed per square yard on average areas of the various sections under maize. The following counts per square yard were obtained: 80, 90, 120, 100, 80, 42, 41, 89, 76, 179, 284, 376, 371. These figures represent the average of a number of separate counts in each case. It

should be borne in mind that the heavy and continuous rains during the latter half of November, and the whole of December, were most unfavourable to the germination of the parasite. The counts of witchweed are given in the statements of the operating expenses for the four fields under maize.

It is not proposed, for several years at least, to give costs of the individual farm operations such as cultivation, ploughing, disc-harrowing, drag-harrowing, etc., since it is considered that reliable figures can only be obtained by taking the average cost over several years. It may be said, however, that the 6 feet spacing between rows of maize greatly reduces the cost of inter-row cultivation by machine, and greatly speeds up the work, as was to be expected. The acreage planted by hand at a spacing of 6 feet by 18 inches per native per day is approximately doubled as compared with hand-planting at 36 inches each way.

The use of single oxen in head-yoke harness with a suitable implement has (on clean land) reduced the hand-labour on witchweed control very greatly, and the latter is confined practically to the parasites growing in the rows of maize. The packing of the soil by the oxen, too, is reduced by 75 per cent. as compared with normal equipment.

The junior author has been responsible for the recording of all the costs, and the senior author for their method of presentation here.

Field No. 17.—Sections B & C.

	Crops.
Area: 20 acres.	Section B.—3 traps of Rhodesian Sudan and sunnhemp (15 lbs. per acre) sown with last trap.
Seeding rates: Sudan, 20 lbs. per acre.	Section C.—2 traps of Rhodesian Sudan followed by 1 crop sunnhemp (20 lbs. per acre).
Dates of sowing and killing the trap crops.	1st trap: Sown 17/11/39. Killed 23/12/39.
	2nd trap: Sown 24/12/39. Killed 25/1/40.
	3rd trap: Sown 6/2/40. Killed March, 1940.

Items	Cost per acre.	Total cost.	No. of labour days.
	s. d.	£ s. d.	
1. Preparation of land	3 3½	3 5 11	58
2. Spreading and covering fertiliser	0 6¼	0 10 8	12
3. Fertiliser	2 3½	2 5 9	
4. Seed	4 5¼	4 8 8¾	
5. Sowing and covering seed ...	0 5½	0 9 0	8
6. Killing Sudan by disc-harrow	0 7½	0 12 6	12
7. Sowing and covering seed ...	0 7½	0 12 6	12
8. Killing by ploughing	2 2½	2 4 4	48
9. Discing re-growth to kill it ...	0 7½	0 12 4	8
10. Sowing and covering seed ...	0 7½	0 12 4	8
Gross operating expenses	15 8½	£15 14 0¾	166 or 8.3 per acre.

Analysis of Expenses.

	Per acre.	Per cent.
	s. d.	
Labour	8 11¾	57.16
Seeds	4 5¼	28.25
Fertiliser	2 3½	14.59
	15 8½	100.00

NOTES

Item 3.—150 lbs. of rock phosphate was applied to the whole area. On half the area (10 acres) the sunnhemp was cut for hay and on the other half it was ploughed under. Where the crop was ploughed in the whole cost of the fertiliser is charged to the following crop of maize, and 6 per cent. interest for 12 months on the capital invested is charged against the trap crops Where the sunnhemp is reaped for hay, half the cost of the fertiliser is charged against the trap crops and half against the following maize crop

Item 4.—Since no market exists in seed of Rhodesian Sudan grass it has been charged at the cost of production on the farm, namely, 8s. 7½d. per 200 lbs.

Items 5, 6 and 7.—The crop was disc-harrowed, and the second crop then sown and covered by a second disc-harrowing, which also served to help in killing the first crop.

Item 9.—Some re-growth of the Sudan grass was killed by disc-harrowing. The cost of the final ploughing is charged against the following maize crop under item "Preparation of land." The river Marodzi overflowed its banks on several occasions during the season and flooded this land.

Nett cost of trap-cropping when sunnhemp and last trap crop were mown for hay.

On half the above land the sunnhemp and trap crop were mown and made into hay. The cost of this operation is shown below.

AREA CUT FOR HAY—10 ACRES.

	Cost per acre.	Total cost.	No. of labour days.
	s. d.	£ s. d.	
11. Mowing	0 7	0 5 9	6
12. Raking and cocking	1 0	0 10 2	12
13. Stacking	1 8	0 16 6	20
	3 3	£1 12 5	38

The yield of hay was approximately one ton, and this is valued at only £1 per ton, as it was rather coarse.

There has therefore been a profit on the trap-cropping of this 10 acres as shown below.

Operating expenses of trap-cropping	£7	17	0½
Operating expenses in making sunnhemp hay	1	12	5
	£9	9	5½
Less the value of 10 tons hay at £1 per ton	£10	0	0
Profit	0	10	6½

NOTE.

It must be borne in mind that the late rains in March favoured a good yield of hay from the final trap crop, and a somewhat lower yield than that recorded above must normally be expected

Profit per acre of land trapped 1s. 0½d.

FIELD 17.—SECTIONS D. & E.

Area: 20 acres.

Seeding rates:

Sudan 20 lbs. per acre.

Amber Cane 20 lbs. per acre.

Sunnhemp 15 and 20 lbs. per acre.

Fertiliser: 150 lbs. per acre of rock phosphate.

Dates of sowing and killing trap crops.

Crops.

Section D.—One trap Rhodesian Sudan grass.

One trap crop Amber Cane.

One crop sunnhemp.

Section E.—Two traps of Amber Cane and one of sunnhemp.

1st crop: Sown 21/11/39.
Ploughed in 5/1/40.

2nd crop: Sown 7/1/40.
Ploughed in 28/2/40.

Sunnhemp: Sown 7/3/40.
Ploughed in May, 1940.

Items.	Cost per acre.	Total cost.	No. of labour days.
1. Preparation of land	£0 3 3½	£3 5 11	58
2. Spreading and covering fertiliser	0 0 6½	0 10 8	12
3. Fertiliser	0 0 5¾	0 9 9¾	
4. Seed	0 9 8	9 13 4¾	
5. Sowing and covering	0 0 9¼	0 15 4	16
6. Ploughing under	0 1 10¼	1 17 1	36
7. Disc-harrowing	0 1 1¾	1 3 0	24
8. Sowing and covering	0 0 7	0 11 6	12
9. Ploughing under	0 2 5	2 8 6	36
10. Disc-harrowing	0 0 7¾	0 12 10	12
11. Sowing	0 0 4¼	0 7 0	8
12. Cartage	0 0 0½	0 0 10	
	£1 1 9½	£21 15 10½	214 or 10.7 per acre.

Analysis of Expenses.

	Per acre.	Per cent.
Labour	£0 11 7¾	53.44
Seeds	0 9 8	44.35
Fertiliser	0 0 5¾	2.21
	£1 1 9½	100.00

NOTES.

Item 3.—Since no crop is removed from the land the cost of the fertiliser applied (150 lbs. per acre of rock phosphate) is charged against the following maize crops,' but 6 per cent. interest on the capital invested in the fertiliser for one year is charged against the trap crops. The cost of the final ploughing (not shown above) is charged against the following maize crop under item "Preparation of land."

Item 4.—On half the area (i.e., 10 acres) one crop of Rhodesian Sudan was followed by a crop of Amber Cane, which was followed by sunnhemp. On the other half of the area two crops of Amber Cane were followed by sunnhemp. All these crops were ploughed under. The cost of seed was 8s. 7½d. per 200 lbs. for the Sudan (cost of production on the farm); 38s. per 200 lbs. of Amber Cane; and 26s. 2d. per 200 lbs. of sunnhemp. The river Marodzi overflowed its banks on several occasions and flooded this land.

FIELD No. 1.B.

Area: 10 acres.

Yield: 89 bags.

Fertiliser: 200 lbs. bonemeal per acre.

Crop: Maize.

Date of planting: 4/12/39.

Yield per acre: 8.9 bags.

Average count of witchweed plants per square yard—80.

Items	Cost per acre	Cost per bag.	Total cost.	No. of labour days.
	£ s. d.	s. d.	£ s. d.	
1. Preparation of land	0 4 7	0 6.16	2 5 9	36
2. Fertiliser and application	0 8 11¾	1 0.10	4 9 9	2
3. Seed	0 3 0	0 4.04	1 10 0	
4. Planting by hand and thinning	0 5 5	0 7.30	2 14 2	
5. Cultivation (ordinary) ...	0 1 2½	0 1.61	0 12 0	12
6. Cultivation (witchweed control)	0 7 1	0 9.53	3 10 9	99
7. Stalk borer control	0 0 1	0 0.12	0 0 10½	1
8. Harvesting	0 6 1½	0 8.27	3 1 4½	68
9. Shelling	0 2 7¼	0 3.50	1 6 0	
10. Bags, twine and sundries	0 6 11	0 9.34	3 9 4	
	£2 6 0	5 2	£23 0 0	218 or 21.8 per acre.

Analysis of Expenses.

	Per acre.	Per bag.	Per cent.
	£ s. d.	s. d.	
Labour	1 7 1¼	3 0.56	58.92
Seeds	0 3 0	0 4.04	6.52
Fertiliser	0 8 11¾	1 0 10	19.52
Stores	0 6 11	0 9.30	15.04
	£2 6 0	5 2.00	100.00

NOTES.

Item 2.—This field was dressed with 200 lbs of bonemeal (4% nitrogen) per acre, and 70 per cent. of the cost of this is charged against the field this year.

Item 4.—Rain much interfered with planting. The lost labour is included here, but will be recorded separately in future.

Item 10.—Second-hand bags at 8d. each were used.

Field No. 2.

Area: 20 acres.

Yield: 152 bags.

Fertiliser: 200 lbs. per acre double maize.

Crop: Maize.

Date planted: 23/11/39.

Yield per acre: 7.6 bags.

Average count of witchweed plants per sq. yard—90.

Items.	Cost per acre. £ s. d.	Cost per bag. s. d.	Total cost. £ s. d.	No. of labour days.
1. Preparation of land	0 2 5¼	0 3.84	2 8 9	54
2. Fertiliser	0 19 7¾	2 7.02	19 13 0	
3. Seed	0 3 0	0 4.73	3 0 0	
4. Hand planting and applying fertiliser	0 7 1¼	0 11.23	7 2 4	180
5. Thinning and hand cultivation...	0 1 2¾	0 1.95	1 4 10	30
6. Machine cultivation	0 0 5	0 0.66	0 8 5½	9
7. Cultivation to control witchweed (hand and machine)	0 7 0	0 11.06	7 0 2½	160
8. Harvesting	0 2 9½	0 4.41	2 15 10½	62
9. Shelling	0 2 2½	0 3.50	2 4 4	
10. Bags, twine, sundries ...	0 6 0¾	0 9.58	6 1 4	
	£2 11 10¾	6 10	£51 19 1½	495 or 24.75 per acre.

Analysis of Expenses.

	Per acre. £ s. d.	Per bag. s. d.	Per cent.
Labour	1 3 2¼	3 0.67	44.41
Seeds	0 3 0	0 4.73	5.81
Fertiliser	0 19 7¾	2 7.02	38.04
Stores	0 6 0¾	0 9.58	11.74
	£2 11 10¾	6 10.00	100.00

NOTES.

Item 4.—After opening the holes for planting a very heavy rainstorm partially filled them, and it was necessary to re-open them to enable fertiliser to be applied. This and much interruption by rain accounts for the excessive cost.

Item 10.—Second-hand bags at 8d. were used.

Field No. 7.

Area: 46 acres.

Yield: 169 bags.

Fertilser: 200 lbs. per acre of bonemeal.

Crop: Maize.

Date of planting: Nov.-Dec., 1938

Yield per acre: 3.67 bags.

Average count of witchweed plants per square yard—100.

A Labour-Saver in Making Compost.

Fig 1.—View of under-side of scoop, showing how the iron bars are riveted on.

Fig. 2.—View of scoop from above, showing the position of the bars in relation to the draw-bar. Note welding of edge of scoop to the bars.

The above photographs illustrate the simple adaptation of a dam-scoop which was described in an article which appeared in the June issue of this Journal.

It saves much hand labour in the emptying of cattle kraals since two oxen will pull it, and the metal tines enable the scoop to get a bite on the trampled mass of materials.

Items	Cost per acre.			Cost per bag		Total cost.			No. of labour days.
	£	s.	d.	s.	d.	£	s.	d.	
1. Preparation of land	0	4	2½	1	1.77	9	14	0	192
2. Fertiliser and application	0	8	11¾	2	5.35	20	13	4	12
3. Seed	0	3	3	0	10.65	7	10	0	
4. Planting...	0	3	10	1	0.52	8	16	4½	245
5. Singling and hand cultivation	0	1	9½	0	5.91	4	3	3½	105
6. Stalk borer control	0	0	0¾	0	0.22	0	3	2	4
7. Cultivation (ordinary) ...	0	0	10	0	2.70	1	18	1	36
8. Cultivation (witchweed control)	0	4	8	1	3.27	10	15	2	299
9. Harvesting	0	2	9¼	0	9.11	6	8	4	170
10. Bags, twine and sundries	0	3	7½	0	11.82	8	6	7	
11. Shelling	0	1	0¾	0	3.50	2	9	3½	
	£1	15	2	9	6.86	£80	17	7½	1063
						or 23.1 per acre.			

Analysis of Expenses.

	Per acre.			Per bag.		Per cent.
	£	s.	d.	s.	d.	
Labour	0	19	3¾	5	3.04	54.91
Seeds	0	3	3	0	10.65	9.24
Fertiliser	0	8	11¾	2	5.35	25.55
Stores	0	3	7½	0	11.82	10.30
	£1	15	2	9	6.86	100.00

NOTES

Item 2.—70 per cent. of cost of fertiliser is charged this year.

Item 4.—Four different methods of planting were demonstrated on this field. This, and some interruption by rain, is the cause of the high cost.

Item 10.—Second-hand bags were used at 8d each.

FIELD NO. 11.

Area: 63 acres.
Yield: 154 bags.
Fertiliser: Nil.

Crop: Maize.
Date of Planting: 4/12/39.
Yield per acre: 2.44 bags.
Average count of witchweed plants per square yard—182.

Items	Cost per acre.	Cost per bag.	Total cost.	No. of labour days.
	£ s. d.	s. d.	£ s. d.	
1. Preparation of land	0 2 8	1 1.09	8 8 0	192
2. Compost (making and application)...	0 2 1½	0 10.43	6 13 11	
3. Seed and treatment... ...	0 3 4½	1 4.64	10 13 6	
4. Planting by hand	0 3 2½	1 3.82	10 3 0	258
5. Cultivation and thinning	0 2 0	0 9.87	6 6 9	40
6. Control of witchweed by hand and machine... ...	0 4 11	2 0.07	15 8 11½	434
7. Stalk borer control	0 0 1	0 0.37	0 4 9	
8. Harvesting	0 2 1½	0 10.49	6 14 8	162
9. Shelling	0 0 8½	0 3.49	2 4 11	
10. Bags, twine and sundries	0 1 7½	0 8.03	5 3 2	
	£1 2 10	9 4.30	£72 1 8	1086 or 17.23 per acre.

Analysis of Expenses.

	Per acre.	Per bag.	Per cent.
	£ s. d.	s. d.	
Labour	0 17 9	7 3.63	77.74
Seeds	0 3 4½	1 4.64	14.78
Fertiliser	—	—	—
Stores	0 1 8½	0 8.03	7.48
	£1 2 10	9 4.30	100.00

NOTES.

The count of witchweed plants given above is the mean of average counts on eight different sections of the field. On two sections the average counts per square yard were 371 and 376 respectively.

Item 2.—15 acres were dressed with compost at the rate of 10 tons per acre. 60 per cent. of the cost of making and spreading it is charged to this crop.

Item 4.—The maize was check-row planted by hand at a spacing of 36 inches each way. Four seeds per "hill" were planted, and the stand was thinned to 2 plants per "hill." Planting was interrupted by rain.

Item 7.—Infestation by borer was slight and only infested plants were treated.

FIELD No. 18.

Area: 15 acres.
Yield: 11 bags.
Fertiliser treatment: 200 lbs. per acre of rock phosphate.

Crop: Rhodesian Sudan grass for seed production for trap-cropping.
Date of Planting: 12/12/39.
Yield per acre: 0.73 bag.

Items	Cost per acre.	Cost per bag.	Total cost.	No. of labour days.
	£ s. d.	s. d.	£ s. d.	
1. Preparation of land	0 2 7	0 3 6½	1 18 9	32
2. Fertiliser and application...	0 11 4¼	0 15 5½	8 10 2	6
3. Planting by machine ...	0 0 6	0 0 8¼	0 7 5	8
4. Seed	0 0 3	0 0 4	0 3 9	
5. Harrowing	0 0 6½	0 0 8¾	0 8 1	6
Total cost of laying down	0 15 2¾	£1 0 9	£11 8 2	52 or 3.4 per acre.
6. Harvesting seed by hand	£0 2 4½	0 3 3	£1 15 8	64 or 4.4 per acre.

Cost of Producing Seed (1939-40)—

7. One-fifth of cost of laying down (£11 8s. 2d.)...	£2 5 7½
8. Interest at 6 per cent.	0 13 8¼
9. Harvesting 11 bags of seed	1 15 8
	£4 14 11¾
Cost per bag of seed (200 lbs.)	0 8 -½
Cost of seed per acre of land trapped (at 25 lbs. per acre)	12.91d.

Analysis of Expenses.

	Per acre	Per cent.
A. Laying down—	s. d.	
Labour	3 7½	23.80
Seeds	0 3	1.65
Fertiliser and application ...	11 4¼	74.55
	15 2¾	100.00

	Per acre.	Per bag.	Per cent.
B. Seed Production—	s. d.	s. d.	
Proportion of cost of laying down	3 0½	4 1¾	47.61
Interest on capital	0 11	1 2½	14.35
Harvesting	1 6½	3 3¼	38.04
	5 6	8 7½	100.00

NOTES.

Item 7.—This seed production plot will remain down for 5 years, by when the trap-cropping will be completed. Therefore one-fifth of the total cost of laying down the plot is charged against the cost of production of the seed each year.

Item 3.—The seed was sown in 36 inch rows by maize planter.

Item 6.—Harvesting was done by hand; individual flower heads being reaped as they ripened. The yield is very low owing to the exhaustion of the soil. Yields of 2 to 4 bags of seed per acre are to be expected on fertile soil.

Field No. 5.

Area: 19 acres.
Fertiliser: 210 lbs. per acre of rock phosphate.
Seeding rates:
Rhodes grass 6 lbs. per acre.
Paspalum 6 lbs. per acre.

Crop: Paspalum diltatum and Rhodes grass pasture.
Date of sowing: 17/11/39.

Items.	Cost per acre.	Total cost.	No. of labour days
1. Preparation of land (ploughing, disc-harrowing 3 times, drag-harrowing once)	£0 3 2¾	£3 1 3½	81
2. Spreading fertiliser (by machine)	0 0 3	0 4 9	4
3. Sowing Paspalum (Cahoon broadcaster)	0 0 4	0 6 4	8
4. Covering (spike harrow)	0 0 3¼	0 5 2	6
5. Sowing Rhodes grass (Cahoon broadcaster)	0 0 4	0 6 6	8
6. Covering with brushwood, by hand	0 0 5	0 7 11	10
7. Mowing weeds	0 0 5½	0 8 5	10
8. Fertiliser	0 11 5½	10 18 0	
9. Paspalum seed	0 8 5	8 0 0	
10. Rhodes grass seed	0 9 5½	9 0 0	
	£1 14 7½	£32 18 4½	127

Analysis of Expenses.

	Per acre.	Per cent.
Labour	£0 5 3½	15.28
Seeds	0 17 10½	51.62
Fertiliser	0 11 5½	33.10
	£1 14 7½	100.00

NOTES.

Item 3.—The seed was divided into two equal portions and the field was sown twice, using half the seed each time.

Item 5.—See under item 3.

Items 9 and 10.—The seed was Australian grown—purchased locally. Similar seed was imported in 1939 by a farmer at a cost of 1s. per lb.

Item 8.—Normally phosphatic fertiliser would not be applied, but it was used in this instance as a form of insurance, since it was feared the soil might have been seriously exhausted by previous cropping.

COMPOST.

A total of 240 cubic yards were made.

System of Making.—This compost was made during the winter from veld grass, which was mown and swept to the side of a temporary kraal by means of a hay rake, a hay sweep, and a hay-drag. After being placed under cattle in the kraal it was removed and placed in a shallow pit (2 feet deep), which was sited a few yards from the kraal. The soil was taken from nearby and wood ash was the only material carted to the site. Water was supplied from a neighbouring pool of a small stream, and was pumped up to the pit by means of a double-acting hand-power pump, and distributed by a hose and adjustable spray-nozzle.

The growth of veld grass was light, and this made the cost of mowing and sweeping to the kraal high. The cattle could not be kept in the kraal a sufficient time to supply enough dung and urine owing to loss of condition due to lack of feed, and in consequence several turns more than would normally be necessary had to be given.

The average length of haul to the field was 1,780 yards, and the compost was accurately spread on four measured strips of land of 5; 5; 2½ and 2½ acres respectively at the rate of 10 tons per acre.

Items.	Cost per cu. yd.	Total cost.	No. of labour days
	d.	£ s. d.	
1. Mowing	3.25	3 4 11	82
2. Raking and sweeping to the pits	1.40	1 8 2	34
3. Filling pits, adding soil and wood ash	.71	0 14 2	16
4. Water supply	.45	0 9 0	12
5. Six turns	2.89	2 17 9	71
Total cost of making compost	8.70	£8 14 0	
6. Hauling to field and spreading	2.46	2 9 3	75
Total cost of making and spreading	11.16	£11 3 3	290=1.2 days per cu. yd.

NOTES.

Item 5.—This cost is on the high side, owing chiefly to lack of experience of the staff. The last three turns, however, cost 8 labour-days, or 5s. 9d. each. Each native therefore turned 30 cubic yards in a day, and the cost per cubic yard was 0.28d. The average cost of labour and rations on this job was 21s. 6½d. per native per month.

The Raising of Bacon Pigs.

By A. E. ROMYN, Chief Animal Husbandry Officer, and C. A. MURRAY, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate,
with a Veterinary Section by D. A. LAWRENCE, Director of Veterinary Research.

Introduction.—Since this Bulletin was first published the Pig Industry in this Colony has progressed a great deal. The present status of the industry is well described in the opening paragraphs of the Annual Report of the Pig Industry Board for the year ending 31st December, 1940.

In this report the Pig Board gives as its views that :—

"During the period under review* the Pig Industry made sound and steady progress. There was no ill-conceived boom in production, but it has been evident that the lack of confidence in the industry which resulted from conditions before the Board was established has been overcome. The number of breeding stock in the Colony increased during the year by 24 per cent., and stud breeders report that they are still booked up with orders for months ahead of their output. Many small farmers are now deriving the main part of their cash income from pigs, and a number of others are registering as producers from month to month.

"The Board does not advocate a boom in production by inexperienced producers. Pigs need not only skilled and experienced management, but a certain outlay of capital. For this reason new producers have always been advised to start in a small way and to develop their operations only as their results may justify. The Board is, however, impressed by the good results obtained by many farmers, and having in view that, notwithstanding the considerably increased production, the supply of pigs to the market has in successive years fallen far short of the demand, it has been confident in recommending farmers of experience to increase their breeding herds.

*For the year 1940.

"An important factor in the increased confidence in the industry was the introduction in August of a control of the importation of pig products by means of a permit system. The development protects the industry against excessive imports of cheap bacon from surplus stocks in the Union of South Africa, and it has therefore removed the fear that the maintenance of prescribed minimum prices, representing a reasonably remunerative return to the producers of bacon pigs, would be beyond the Board's powers. The Board can give an assurance to the industry that for some time to come its available funds will be sufficient to enable it to take over all surplus pigs of exportable quality at the ruling local market prices. These two factors provide a thoroughly sound foundation for future development."

THE BACONER.

The Type of Pig Required.—Certain parts of a bacon side are more in demand and have a higher value than other parts. The valuable parts are the middle and the hams. The fore end is of much less value.

The desired type of pig is one which has the maximum development in the valuable parts, and should have the following characteristics:—

(*a*) *Conformation.*—Great length between the shoulder and ham. The back should be slightly ached and be of medium and uniform width from rump to shoulder. The sides should not be too deep, but of uniform depth from chest to flank. The shoulder should be as light and fine as possible, showing no signs of coarseness and blending smoothly with the sides. The finer and lighter the jowl and neck the better, as these parts have relatively little value. The hams should be well developed, broad, plump and well let down to the hocks. There is a tendency here to neglect the development of the ham owing to the difficulty of disposing profitably of hams on the local market. A deficiency on the ham is, however, a serious weakness in the export pig. The underline should be firm, full and show no signs of flabbiness.

A baconer should give one the impression of a long, lean, well-fleshed pig showing no excessive tendency to lay on fat. The short, broad, deep, lard type of pig should be avoided altogether. Figure 1 illustrates the correct type.

(*b*) *Quality.*—It is of importance that the baconer should show quality and thriftiness. A thin, smooth skin and fine covering of hair indicate these. Any sign of coarseness, such as is found in a heavy shoulder, wrinkled skin and rough hair, is most undesirable.

(*c*) *Finish.*—When marketed the baconer should be well finished, *i.e.*, the back, sides and underline should be well filled and have a smooth and full appearance. The back fat of an unfinished pig is generally too thin and soft, and the whole carcase has a flabby appearance. The over-finished pig, on the other hand, is too fat for the production of the best quality bacon.

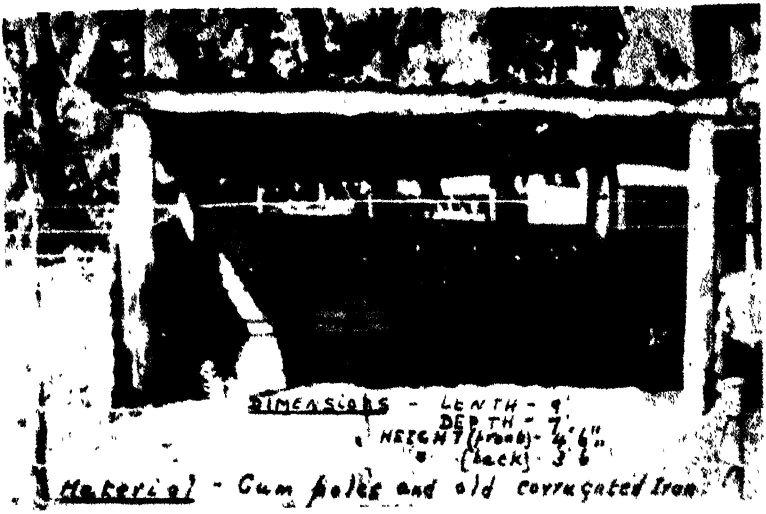
(*d*) *Correct Weight.*—The weight at which to market a bacon pig depends on the type of pig. The longer the pig, the heavier is the weight to which it has to be fed to secure a proper finish. The shorter the pig, the lighter is the weight at which it can be marketed.

The correct weight is also influenced by the ration. Pigs fed largely on maize are ready for market at lighter weights than pigs that have been fed on well balanced rations.

A liveweight of approximately 200 lbs. is generally taken as the standard for the Large White or Tamworth x Large Black cross when properly fed. The local market favours lighter weights at present, but it is likely that, as the general type and feeding of the pigs improve, the present popular weights of 170-180 lbs. will gradually increase to the 200 lbs. figure.

It requires careful judgment to determine the correct degree of finish for marketing.

The Type of Bacon Carcase Required.—After the pig has been killed, bled, scalded, scraped and singed, the entrails, heart and liver and lungs are removed. The carcase then is weighed to obtain the dressed weight of the pig. This weight should be from 75 per cent. to 80 per cent. of its weight before slaughter. The carcase is then split and the backbone, head, tail, leaf fat, tenderloin, kidney fat and kidneys are removed. The two sides are now separated, and it is not until this stage that a reliable judgment can be made as to the suitability of the pig for bacon production. Figure 2 shows desirable and undesirable bacon carcases.



A simple colony house.

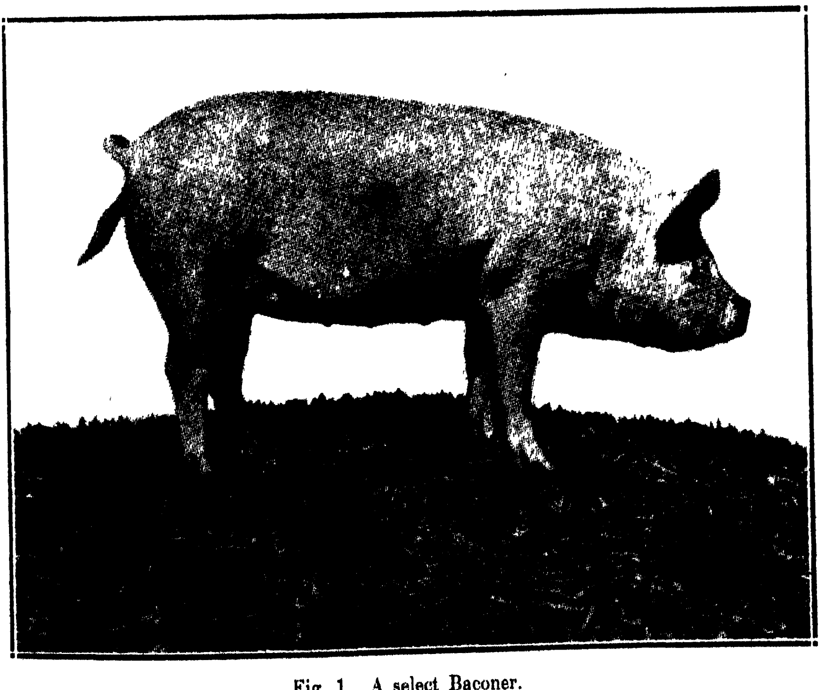


Fig. 1. A select Baconer.
(From Pamphlet No. 40, Canadian Department of Agriculture.)

Fig. 2. Desirable and undesirable sides of the same weight The shorter side is over fat and is too heavy in the fore end.
(From Economic Report No. 17, Ministry of Agriculture and Fisheries.)

The side should have an even covering of back fat, not exceeding 2-2⅛ inches over the shoulder and tapering slightly from shoulder to ham. An uneven layer of too thick or too thin back fat is a very serious fault. The belly and flank should also be thick and full of substance and not less than 1¼ inches thick. There should be no signs of seedy cut (see next section), and the side should show no signs of bruises, boils, spots or cuts.

The Type of Pork Carcase Required.—The local market tends at present to favour a comparatively light porker but, as the market become more discriminating, the tendency will be to breed up to " standard porker," which should weigh from 100-115 lbs. live weight.

The ideal porker should be under five months of age. It should be well finished and smooth; comparatively light in the shoulder; with firm, slightly arched back and well sprung ribs. The hams should be plump and well let down.

A good proportion of lean meat in the carcase in proportion to the fat is very important. This proportion is influenced by both breed and feeding.

Figure 3 shows a number of different types of porker carcases cut through at the last rib. The right proportion of lean to fat is shown by pig No. 112. An excessive amount of fat in relation to the amount of lean is shown by pigs 136 and 177 in the same figure.

The following are some common carcase defects in baconers. In most cases they apply to porkers as well.

(*a*) *Deficient Length.*—Not only is it desirable to have a long middle because of the relatively high value of the bacon obtained from it, but a short pig usually has other undesirable features, such as too much fat and heavy shoulders.

(*b*) *Back Fat too Thick or too Thin, or Uneven.*—These faults are among the most serious that a bacon carcase can have. At present the demand is for lean bacon, and too much fat is seriously discriminated against. An unfinished carcase, on the other hand, with too thin back fat, produces a soft, flabby side unsuitable for bacon production.

The desirable depth of back fat will vary with the weight of the pig.

(c) *Heavy Shoulders.*—This part of the carcase has the lowest value per pound. A heavy shoulder is also generally associated with two other serious defects, *viz.*, deficient length and too much fat.

(d) *Thin Bellies.*—These are undesirable, because of the flabby appearance they give to the carcase and the unsatisfactory rashers that are cut from them. Unfinished, badly bred and unthrifty pigs usually suffer from this defect.

(e) *Soft Fat.*—A soft carcase soon goes rancid. It has an oily and flabby appearance, and is most undesirable. Unthrifty, slow maturing, unfinished pigs generally have soft fat. The feeding of ground nuts, soya beans and sunflower seed produce the same effect. Early maturing, thrifty, well-finished pigs are generally firm.

(f) *Seedy Cut,* found in the belly fat of pigs, is due to an infiltration of the skin pigment, and has a speckled appearance resembling small seeds. It is only visible in black pigs. Although in no way harmful, the discolouration spoils the appearance of the bacon and often results in the cutting out of large pieces of belly bacon to be used for rendering into lard.

(g) *Meat of Poor, Quality.*—Some breeds or crosses produce coarse meat. The lean meat of an unfinished pig will usually be poorly marbled. Good quality meat is well marbled, light in colour and has a fine grain. Black pigs have darker coloured meat than white pigs. Generally, well bred and well fed pigs have good quality lean meat.

(h) *Blemishes.*—Bruises, boils, cuts or spots on the carcase constitute blemishes and detract greatly from its appearance and value. Rough handling is the usual cause of blemishes.

FACTORS WHICH INFLUENCE THE VALUE OF A PIG FOR BACON AND PORK PRODUCTION.

(1) **Breeding.**—Certain types and breeds of pigs are unsuitable for production of lean, sizeable bacon. They may be too fat, too heavy in the jowl or shoulder, too thin in the belly or too light in the hams. Such types or breeds should not be used for bacon production. Even in the typical bacon breeds—Large White and Tamworths—we often find sows

which produce pigs that are " off-type " and unsuitable for bacon production. Figure 4 shows desirable and undesirable sides. Boars and sows which produce such pigs should be culled immediately from the breeding herd.

The most common breeds in the Colony at present are the Large Black and the Large White. A few Tamworths are maintained, and it is thought that the numbers of this breed will increase in areas where white pigs do not appear to thrive as well as dark pigs.

Typical specimens of these breeds are shown in figures 5, 6 and 7.

The Large White is the leading bacon sire in the bacon producing countries in the world to-day. The Large Black sow is favoured in this Colony on account of its hardiness, good motherhood and proficiency. The Large White sow, however, is becoming increasingly popular where conditions for pig raising are good.

The commercial baconer and porkers is commonly a first cross, a cross recommended by the Department being that of the Large White boar with the Large Black sow. Where white pigs are not satisfactory the Tamworth boar can be used in place of the Large White boar. Both these crosses serve the dual purpose of producing a pig suitable for either the baconer or porker trade, depending on how it is finished. The thicker pigs can be forced after weaning and marketed as porkers. The longer and leaner pigs can be carried on to bacon weights. The former cross is preferred by the market on account of its white skin.

The pure Large Black is generally unsuitable for bacon production on account of its tendency to produce coarse flesh and inferior bacon conformation. The Large Black sow is, however, retained for crossing with the Large White and Tamworth boars on account of its availability and its hardy, prolific and motherly qualities.

Feeding and Management.—"Feeding" and "management" are as important as "breeding" in the production of the right type of baconers and a well bred baconer, if wrongly fed and managed, will not develop into a good pig, although it may have the inherent ability to do so. Wrong feeding and

management may result in soft fat, too thick or too thin and uneven back fat, slow maturity, expensive gains, poor quality meat, stunted, unthrifty, and poor type pigs.

Common Errors in Feeding and Management.—The following practices should be guarded against:—

(a) *Under-feeding and the use of Unbalanced Rations.*—These result in slow growing, stunted, unthrifty pigs that make expensive gains. Bad feeding may cause the fat to be soft and the carcase to be of poor quality. Usually the faster the pig grows the cheaper it is to produce and the better the quality of its meat, provided it is not over-fat.

(b) *Incorrect Finish.*—An unfinished pig is undesirable, and usually produces a flabby carcase with soft fat, a thin belly and poor quality meat. It is of importance to feed the pig until it has the correct finish without allowing it to get overfat.

(c) *The Use of Excessive Fattening or Oil-containing Feeds.*—Some feeds should not be used for bacon pigs. Kaffir corn has a tendency to produce too much fat. Ground nuts, soya beans and sunflowers produce soft, oily fat, and should not be fed to baconers.

(d) *Poor Housing, Bad Sanitation, etc.*—These all tend to impair the general health and well-being of the pig, and so prevent it from growing out economically or producing the quality of bacon which it is capable of doing under proper conditions.

THE BREEDING HERD.

Selection.—Particular attention should be paid to the selection of stock for the breeding herd, as on their suitability or otherwise will depend to a large extent the success of the business. The pigs selected should be typical of the breed, pure-bred, and, if possible, registered. Pure bred pigs are comparatively cheap and cross-bred or grade sows should not ordinarily be used, as they do not produce such uniform litters. Breeding stock should not be selected too young. The boar should not be chosen under six months or the gilts under three to four months of age. Even at these ages it is hardly possible to form an accurate estimate of their future development. It

is important to select the breeding pigs from sows that are known to have produced and reared large uniform litters of the correct type.

The head, conformation, and carriage of the boar should show character and masculinity without being coarse. The sows should show feminity, character and no signs of masculinity. Both sexes should have good length, be relatively fine and light in the shoulder and jowl, strong in the back, with a slight arch from the shoulder to the rump. The ribs should be sufficiently well sprung to indicate constitution and the sides should be smooth, and blend well with the fore and hind-quarters. The hams should be full, well developed and well let down into the hocks. The legs should be short and strong, and particular attention should be paid to the pasterns, which should be strong and straight. There should be evidence of quality throughout. Quality is indicated by a smooth, clean-cut appearance, a fine skin, fine silky hair, fine bones and light shoulders. A glossy coat is evidence of health and should be looked for.

The sow should be of quiet disposition, as a nervous and irritable sow often kills a large proportion of its progeny, and is seldom a good doer. The udder should be sound and there should be not less than six pairs of well-developed teats. In the gilt the teats should be well developed and not have the appearance of small "buttons." The boar should have the same number of rudimentary teats. Hard lumps in the udder and blind teats should be watched for in a mature sow.

The Breeding Age.—The best age at which to breed young gilts will depend on their development. Well-developed gilts, weighing 200 to 250 lbs. and over at eight months of age, can be put to the boar. A gilt bred too young or before it has developed sufficiently can only rear properly two or three piglets. This small number will not only affect her udder development, but will also greatly increase the cost of production of the young pigs. If such a gilt is allowed to rear larger litters the strain may permanently stunt its growth and spoil it as a breeder. On the other hand, some pure-bred breeders allow their gilts to grow too old and over-fat before breeding them. This is usually the case with show pigs, and it is an undesirable practice, because it increases the

cost of the young pigs and may even cause temporary or permanent sterility in the sow. Gilts for the breeding herd should get plenty of exercise in order to develop a good frame.

Under average conditions it is unwise to use a boar until it is a year old. It should be used sparingly at first. Experience has shown that over-use of the boar pig will frequently injure its future breeding powers and result in small litters. A mature boar can breed up to 30-40 sows per year if the services are properly distributed. It is not wise to allow the boar to run with the sows unless the herd is small. If there is a big difference in the size of the boars and sows a breeding crate should be used to facilitate service.

The Gestation Period.—The usual period between successful service and farrowing is from 114 to 115 days, or about "three months, three weeks, three days." The following gestation table gives the date of farrowing for sows served on certain dates:—

Gestation or Breeding Table.

Date Served.	Date Due.	Date Served.	Date Due.
January 1.	April 25.	July 1.	October 23.
January 16.	May 10.	July 16.	November 7.
February 1.	May 26.	August 1.	November 23.
February 16.	June 11.	August 16.	December 8.
March 1.	June 23.	September 1.	December 24.
March 16.	July 8.	September 16.	January 8.
April 1.	July 24.	October 1.	January 23.
April 16.	August 8.	October 16.	February 7.
May 1.	August 23.	November 1.	February 23.
May 16.	September 7.	November 16.	March 10.
June 1.	September 23.	December 1.	March 25.
		December 16.	April 9.

Breeding Season.—The sow, if properly fed, comes on heat every three weeks, unless she is pregnant or nursing a litter. The periods between heats is about three weeks (21 days), although it often varies from 18 to 23 days. The "heat" usually lasts for three to four days, and as the ova are usually shed about 30 to 35 hours after the beginning of heat and do not retain their vitality for more than a few hours, the sow

should be served during the first or second day of heat. Where market conditions are secure, it is usually the best practice to have all the sows farrow at more or less the same time. A sow on heat will show a swelling of the vulva and general excitement and will follow other females about. The condition of the boar and sow at service have an important effect on the number of young born. The sow should be in improving condition and the boar in a vigorous, active state.

Number of Litters per Year.—The more young pigs a sow produces and rears successfully per annum the lower will be the cost of production of the weaners. The object should be to get as many litters in as short a time as possible. To let a sow rear one litter and then "board" her for the rest of the year is bad business. The optimum to aim at is two litters per year. This number, however, will be a heavy drain on the sow and she should therefore be well fed and cared for while nursing and during pregnancy. To obtain two litters per annum the young must be weaned at eight weeks of age and the sow served when she comes on heat, four to six days after weaning.

Size of Litters.—Some sows will farrow up to and over 20 piglets at a time. A sow usually has 12 to 14 teats, and it is therefore of little use for her to farrow more than this number. In addition, the piglets in such large litters are usually weak at birth. The most profitable size of litter to rear will depend on the number of teats and the milk yield of the sow. Few sows can rear more than 10 thrifty pigs. Gilts, because of their lower milk yield, should not rear more than 6 or 7 with the first litter. To have a herd average of 8 or more thrifty pigs weaned is considered very satisfactory.

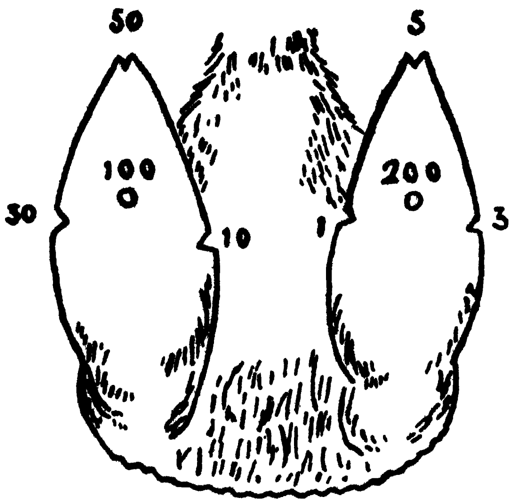
Weaning Age.—With good feeding and management the young pigs should be weaned at about 8 weeks of age, when, if they have been well done, they should weigh 35-40 lbs. A more common weight is, however, 25-30 lbs. Good weaning weights are indicative of good management and the higher the weaning weights the more profitable the pigs will be to feed.

Pigs intended for the breeding herd or those which have not done so well should usually be weaned later at 10-12 weeks of age.

The following weights can be taken as satisfactory at the different ages:—

8 weeks	25 lbs.	12 weeks	50 lbs.
16 weeks	80 lbs.	20 weeks	120 lbs.
24 weeks	160 lbs.	28 weeks	200 lbs.

Castration and Marking.—These operations should be performed at from 4 to 6 weeks of age and not a few days before or after weaning. For castration use clean, sterilised instruments, and put some disinfectant and fly repellent on the wound. At the same time the young pigs should be earmarked (by means of a clipper) according to some definite system. The key below illustrates a satisfactory system.



One notch on the inside of the right ear indicates 1.

Two notches on the inside of the right ear indicates 2.

One notch on the outside of the right ear indicates 3.

One notch on the outside and one on the inside of the right ear indicates 4.

One notch at the tip of the right ear indicates 5.

One notch at the tip and one on the inside of the right ear indicates 6.

One notch at the tip and one on the outside of the left ear, and one notch on the outside and one on the inside of the right ear indicates 84, and so on.

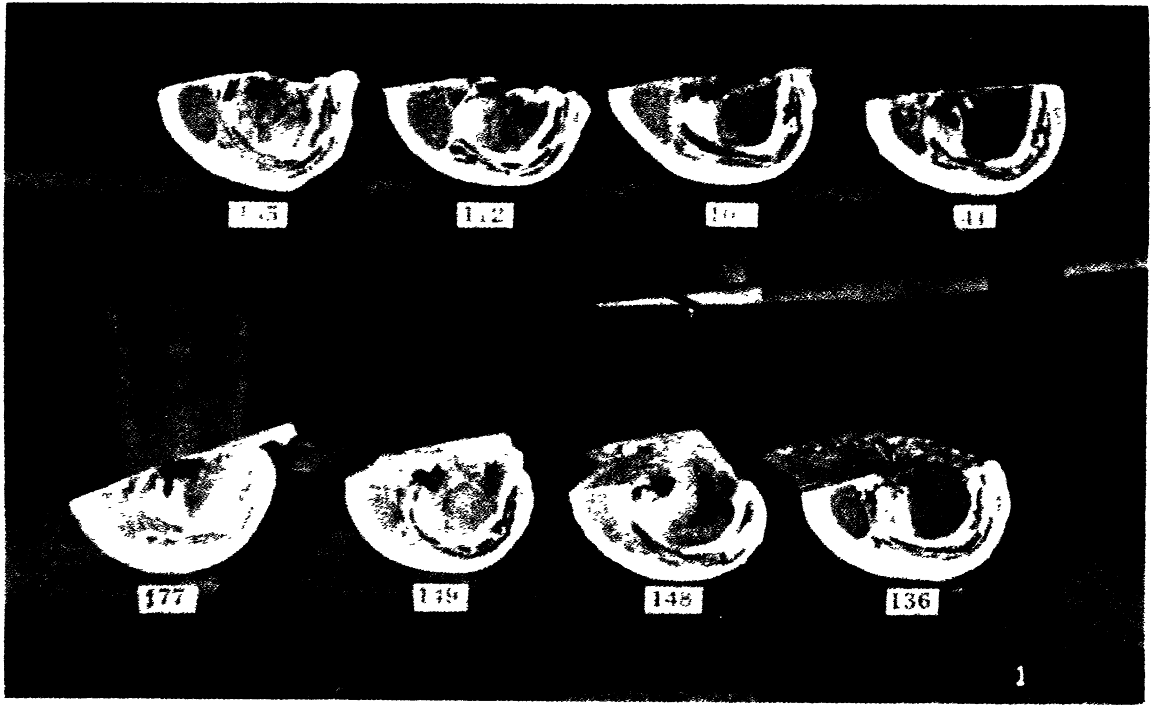


Fig. 3. Pig. No. 112 shows excellent cutting qualities

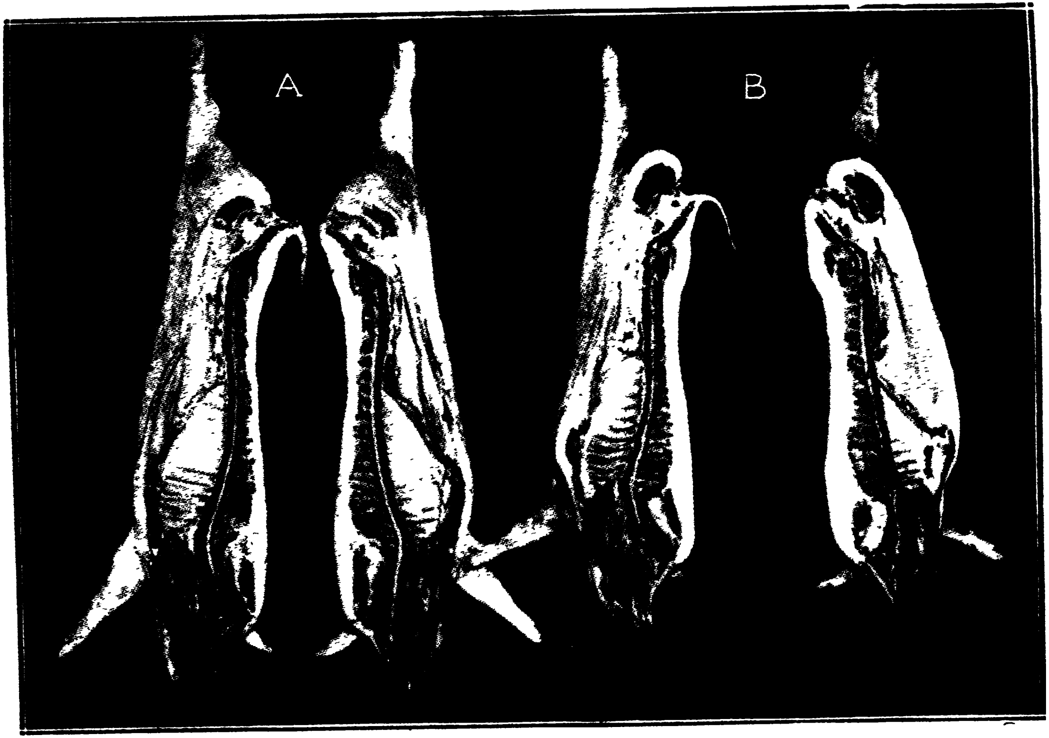


Fig. IV. A. A desirable carcase with good length.
B. An undesirable carcase, short and too fat.
(From Economic Report No. 17, Ministry of Agriculture and Fisheries.)

With this system pigs can be marked from 1 up to 500 or over 600. It will be noticed that if two notches or two holes in the same position indicate double the value illustrated the system is self explanatory; and that the two notches need only occur on the insides of the ears, and are only used when indicating 2, 7, 20 and 70.

Pig Recording. In progressive pig raising countries a system of pig recording rather similar in principale to the ordinary system of milk recording has come into use. Production and feed records are kept of all sows and their progeny, and carcase records are obtained when the baconers are slaughtered. By this means it is possible to determine which sows are the producers of large litters, which use their feed economically and turn out into satisfactory baconers. By breeding from these sows only the productivity and profitableness of the herd is much increased.

All pig farmers should maintain some system of pig recording. The subject is too large to treat here, but particulars of systems suitable for different sets of circumstances can be obtained from the Department of Agriculture.

THE FEED AND MANAGEMENT OF BACONERS AND PORKERS.

General.—Guesswork should have no place in the feeding of pigs. As much attention should be paid to the balancing of rations for pigs as to those for any other form of live stock. The quantity of feed used should be weighed and apportioned correctly, taking into account the size of the pigs and the degree of finish that they have reached. A weighing scale to determine the progress of fattening of growing pigs is as essential on a pig farm as a milk scale is to the owner of a dairy herd.

The pig is handicapped by the relatively small capacity of its digestive system. It cannot handle large quantities of bulky or fibrous feeds. In general, the ration for baconers should be concentrated and digestible, and the pigs should be pushed for the maximum rate of growth in keeping with their type and the system of management in vogue. As a rule the pigs which make the largest daily gains in live weight are the most profitable to the feeder.

Under local conditions there is no grain feed as useful as maize. It is, however, relatively deficient in protein and mineral matter. Kaffir corn, nyouti, barley and oats have the same general characteristics and they can be used interchangeably with maize or as a substitute for part of the maize in the ration. When used as the sole grain they usually have less feeding value than maize, and the high fibre content of oats makes that feed unsatisfactory as a sole grain feed for baconers.

The best protein supplements for the common farm grains are separated milk, butter milk and meat or blood meal. Cow peas and ground nut cake are relatively high in protein, and can be used as substitutes for these animal by-products. They are generally, however, not quite as satisfactory, nor do they, when fed without milk or meat or blood meal, produce bacon of as good a quality. Ground nut cake has a tendency to produce soft bacon, and should not be used extensively for baconers. The wheat by-products, pollard and bran, are excellent supplements to replace part of the maize when available at prices comparable to maize.

Bulky crops such as roots, sweet potato tubers, melons and pumpkins should only be used in moderate amounts for fattening pigs. Usually not over 3-5 lbs. should be fed per head per day. In excess they are reported to cause watery meat and pot-bellied pigs.

The rate of gain will generally be increased by the provision of suitable pasture during the summer months, and by succulent or green feeds during the winter. These green feeds stimulate the appetite of the pig and provide vitamins which may be lacking in the grain ration.

To ensure a proper supply of minerals, the pigs should generally have free access to a mixture of bone meal 3 parts, salt 1 part. Three per cent. of this mixture should be mixed with the grain feed. Charcoal or wood ashes are generally considered beneficial to pigs in sties.

Results of Experiments.—The following results are quoted from Bulletin No. 162 (1936) of the Department of Agriculture and Forestry of the Union of South Africa.

"To gain information on the use of typical South African foodstuffs, a series of experiments has been carried out at

the School of Agriculture, and these are summarised hereunder:—

(*a*) *A Standard Ration.*—It has been found difficult to secure both the desired uniformity in length and the required thinness and firmness of fat under prevailing conditions of feeding, in which maize constitutes the major part of the ration.

As a result of experiments completed to date, a ration consisting of maize meal 90 parts and meat meal 10 parts by weight, supplemented with 3 per cent. of a mineral mixture consisting of sterilised bone meal 3 parts and salt 1 part by weight, and a small daily allowance of green feed, has been adopted as the standard ration for bacon pigs. Although not ideal in many respects, this combination proved to be the most economical system in the Union. Pigs fed on this ration showed a tendency to become finished before the most desirable weight for baconers was reached. It is, therefore, not advisable to force the animals unduly, especially since our work indicates that forcing also may be responsible, to some extent, for the production of shorter pigs. In spite of this precaution some pigs will have to be marketed at weights considerably below the 200 lb. limit, although marketing at too low weights should be guarded against, since considerable evidence was obtained in some trials that the low weights and softness of fat were correlated. More definite evidence was obtained to the effect that an unfinished condition is invariably associated with softness of the fat, consequently care should be taken that all baconers are properly finished.

As regards the effect of this ration on the length of the pigs, the results are somewhat contradictory, but it is fairly certain that the ration exercises only secondary influence in this respect, and that breeding is the major factor determining the length of side. It was observed, however, that in several instances forcing the pigs on the maize meal-meat meal ration appeared to be conducive to the production of relative short and over-fat sides.

The effect of this ration on the firmness of the fat leaves something to be desired. The meat meal, of course, produced a pronounced hardening effect, but it will seldom be possible to procure one hundred per cent. of firm carcases, and a small

percentage of soft carcases can always be expected, especially if no separated milk is fed. This condition could be further improved, however, by increasing the proportion of meat meal, but on the basis of relative prices it is doubtful whether this course would prove profitable to the producer.

(*b*) *A Maize and Barley Ration.*—When 50 per cent. of the maize meal in the standard ration described above was replaced with an equal weight of barley (*i.e.*, maize meal 45, barley 45, meat meal 10 parts by weight) a most suitable ration for the production of lean sizeable bacon was obtained. The addition of barley resulted in the production of a larger percentage of firmer sides, but the length of side produced remained unaffected. Further, increasing the proportion of barley showed no additional effect on either the texture of fat or length of carcass. Although this ration showed a distinct advantage over the standard one, the local production of barley is relatively small as compared with that of maize, with the result that the market value of barley is proportionately higher, consequently the use of a large proportion of barley in the ration was found to increase production costs materially.

(*c*) *Maize and n'Youti Ration.*—The results of a feeding trial indicate that n'Youti may be substituted for barley in the 45:45:10 ration. The pigs on this ration made phenomenal gains, averaging well over 1.5 lbs. daily. They grew well and showed no tendency to become overfat. The quality of the carcases was excellent, and tests are now being conducted to determine the effect of this ration on the firmness of the fat. The results of overseas investigations indicate, however, that n'Youti in the ration of baconers exercises a favourable influence on the firmness of the fat equal to that of barley.

(*d*) *Maize and Separated Milk.*—In the trials in which maize formed the sole grain in the ration, but supplemented with a liberal allowance of separated milk (up to 2 gallons daily per pig) quite satisfactory results were obtained, and it is considered that in localities where an abundance of separated milk is available, this ration would prove more economical than the standard, especially when the pigs have access to pasture.

(*e*) *Maize and Kaffir Corn Ration.*—In a few trials part of the maize meal in the standard ration was replaced by Kaffir corn, with unsatisfactory results, inasmuch as the pigs showed a tendency to produce stout and over-fat carcases, although the Kaffir corn appeared to exercise a hardening influence on the texture of the fat.

(*h*) *Reducing the Protein.*—An attempt was made to reduce by 50 per cent. the proportion of meat meal in the standard ration. Although good gains were made by the pigs on this ration, the quality of the bacon was undesirable in that the marbling was poor. Furthermore, the pigs reached marketable condition at low weights, and consequently showed a tendency to produce soft carcases in addition to a high percentage of No. 2 lean sizeable sides. No reduction in the proportion of meat meal is recommended at this stage of our knowledge.

In fact, there is reason to believe that the protein content of the rations at present fed to young pigs could be increased with advantage."

FEEDS AND FEEDING.

Preparation of Feed.— The grinding of maize results in a saving ot about 5 per cent. of the feed. In the case of pigs under 150 lbs. live weight, the economy effected is somewhat less. Small grains such as Kaffir corn, barley and oats should be ground for pigs. All meals should be fed as a slop. The cooking of the common feeds, except potatoes and beans, decreases their value for pigs. Separated milk should be fed either always sour or always sweet. Usually it is safer to feed it sour. Whey should be fed sweet. Butter milk has of necessity to be fed sour. Cleanliness is especially important with dairy by-products.

Methods of Feeding.—Pigs may be fed in dry lots, in sties or on pasture. The pasture system is little used in Southern Rhodesia. The dry lot, or camp, commonly takes the place of the pasture used in other temperate countries. The lack of good pastures is unfortunate as, where suitable pastures are available, pigs will usually make more rapid and more economical gains during the summer by this method than by any other. The dry lot, moreover, unless the camps are frequently

changed, is unsatisfactory and frequently becomes a source of worm infection for the pigs. When proper pastures or camps are not available, it is probably advisable to keep the baconers in sties from the time they are weaned until ready for market. In fact, where clean ground free from worm infection is not available it is advisable to keep the young pigs in sties from birth until market weights are reached.

RATIONS.

A. For Pigs in Sties or Dry Lot.—Suitable rations are:—

(*a*) *Maize and Separated Milk.*—Suitable proportions to feed these in are:—

Weaning age to 80 lbs. live weight, 3 lbs. separated milk to 1 lb. maize.

80 lbs. to 125 lbs. live weight, 2 lbs. separated milk to to 1 lb. maize.

125 lbs. to market weight, 1 lb. separated milk to 1 lb. maize.

(*b*) *Maize and Meat Meal.*—Assuming meat meal to have a composition of 50-60% protein, the following proportions are recommended:—

Weaning age to 60 lbs. live weight, 13 lbs. meat meal, 87 lbs. maize.

60 lbs. to 130 lbs. live weight, 10 lbs. meat meal, 90 lbs. maize.

130 lbs. to market weight, 7 lbs. meat meal, 93 lbs. maize.

It is not necessary to include bone meal in the mineral mixture when meat meal is used. Kaffir corn, N'youti or barley can be used to replace half the maize when desired.

Some green or succulent feed should be given with both of these rations.

Cow peas or Kaffir beans, pollard, palm kernel cake may be used in place of the protein supplements just named, but in general better results will be obtained where they form not more than 25 per cent. of the grain ration and the remaining deficiency of protein is made up by some animal by-product. A satisfactory general purpose farm mixture would be maize 70 lbs., cowpeas 25 lbs., meat meal 5 lbs.

In sty feeding the addition of 3-5 per cent. of a cut-up legume hay to any ration which does not contain dairy by-products will often improve the rate of gain. This hay can also be fed from a rack or loose in a trough mixed with the meal.

The pigs should be fed all the grain they can clean up in 15-20 minutes after feeding. The daily quantity consumed should usually be equivalent to about 3 per cent. of the live weight of the pig. A 150 lb. pig should consume 4½ lbs. of grain or its equivalent per day. Plenty of trough room should be provided, and the pigs should be graded into lots of equal size and strength. Bad doers should be weeded out as they appear and disposed of to the best advantage.

The following figures are a guide to the quantities of grain ordinarily consumed per day by pigs of different weights:—

Weight of Pig.	Amount of Grain per Day.
50 lbs.	2 lbs.
100 lbs.	3.5 lbs.
150 lbs.	4.5 lbs.
200 lbs.	6 lbs.

When feeding baconers on rations which are comparatively low in protein, it is often desirable to bring them on at a slower rate than the optimum in order to prevent them from getting overfat. Porkers should, however, be generally pushed from the start.

B. For Pigs on Pasture.—On good pasture, poor pastures are usually not worth while, pigs make faster gains in live weight than in sties and require less supplementary protein feed. There is, moreover, a subsidiary advantage, that the pig manure, which is usually lost, is spread on the land without waste.

The most effective arrangement is to plough and sow a fenced area with suitable crops such as maize and velvet beans or cowpeas. This area is then subdivided into smaller camps by temporary fences for grazing. Arrangements should be made for shade and water in each camp and a wallow as well, if possible. It is important to plough up the area each year

or to move the camps to fresh land frequently so as to keep the worms in check. Secure fences are required to keep the pigs from straying.

The amount of grain to feed to pigs on pasture is determined by the rate of grain in live weight desired and by the nature of the pasture. The heavier the grain ration, the less pasture will be consumed. A daily ration of about 2 lbs. of grain per 100 lbs. live weight will generally preserve a fair balance between the pasture and the grain consumptions. Thus pigs weighing 150 lbs. live weight would receive 3 lbs. of grain per day.

The nature of the grain ration will depend on the composition of the pasture and the age of the pigs. The table which follows illustrates the quantity of meat meal (50 per cent. protein) required to balance a maize ration on some typical pastures:—

Pasture Crop.	Pigs weighing less than 100 lbs.	Pigs weighing more than 100 lbs.
Kikuyu, paspalum, any young grass	10% meat meal	5% meat meal
Rape, green rye, oats, and barley	10% meat meal	5% meat meal
Cow peas, velvet beans and kudzu vine......	5% meat meal	None

Instead of 10 per cent. meat meal, 15 per cent. ground nut cake or 2 parts separated milk by weight can be used.

It may be necessary to "ring" pigs running on valuable grass sod.

A mineral lick of 3 parts of bone meal and 1 part of salt should be provided.

It is not generally advisable to keep baconers on pasture throughout the feeding period, and the pigs should usually be grown out on pasture to a weight of 130-150 lbs., and then finished in sties or dry lots. This system produces excellent baconers, and the residual stimulating effect of the pasture generally lasts through the finishing period.

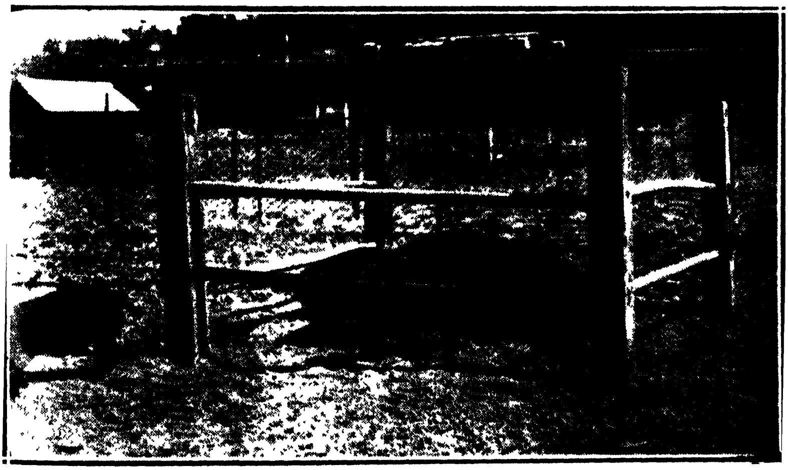
Marketing of Pigs.—If possible, the pigs should be got on to dry feed a day or two before marketing. Pigs ship better

Fig. 6. Large White Sow.

Fig 5 Large Black Sow

Fig. 7. Tamworth Boar.

A good producer



Young pigs feeding in a creep.

empty than full, especially in the hot weather, and under ordinary circumstances the morning feed should be withheld on the day of marketing. The pigs should be handled quietly and in the cool of the day, if possible. The normal shrinkage in transit to market is 5 per cent. to 10 per cent.

The prevent fighting en route pigs from the same sties should be shipped together if possible.

THE FEED AND MANAGEMENT OF THE BREEDING HERD.

Feed for Dry Sows and Gilts.—The feed for dry sows and gilts in the breeding herd should be sufficiently liberal to enable the sow or gilt to farrow in the proper condition and to raise a good litter of pigs. Fat sows produce pigs low in vitality and are clumsy to handle at the time of farrowing, while thin sows cannot nourish the average litter properly. The ration should be well balanced and contain more muscle and bone-forming material than is contained in maize or other grains. As a general guide, mature sows should be fed to gain $\frac{1}{2}$ lb. to 1 lb. daily from the time of breeding to farrowing, and bred gilts, so as to allow for their own growth, somewhat more.

During the summer months pasture is excellent for sows in pig. The range and green feed afforded in this way generally result in large litters and little trouble in farrowing. In the winter months, when pasture is not available, roots or succulent crops such as pumpkins, sweet potatoes or majordas, or a leafy legume hay, should be fed to take the place of pastures.

As the greater part of the development of the embryo pigs takes place during the last six weeks of pregnancy, the ration should be richer in protein—the flesh-forming constituent—during that period than in the earlier stages. The ordinary farm grains, such as maize, Kaffir corn, N'youti, barley, plus a good supply of succulent feed or pasture, will usually be quite sufficient for in-pig sows during the first ten weeks of pregnancy, but during the last six weeks these grains should be supplemented by a protein rich feed. The normal protein requirements at this period can be met by adding 10

per cent. of meat meal or 15 per cent. of ground nut cake, or 2-3 parts of separated milk—all by weight—to the grain ration in use.

If the pasture is scanty and unattractive, feed the sows on a protein supplement throughout the gestation period, increasing the proportion of the supplement towards the end of the period. Good grazing for sows can be found in vleis or on paspalum or kikuyu grass or summer crops sown for the purpose.

The quantity of grain to feed per day should be determined by the condition of the sow. In general, however, $\frac{1}{2}$-1 lb. of grain per 100 lbs. live weight per sow for mature sows and $1\frac{1}{2}$ lbs. per 100 lbs. live weight for bred gilts should be sufficient. A typical ration during the winter months for a mature sow would be:—For the first ten weeks 2-4 lbs. maize meal per day, plus green or succulent feed *ad lib.*, and for the last six weeks of pregnancy, 3-5 lbs. of a mixture of maize 90 per cent., meat meal 10 per cent., plus succulent feed *ad lib.* During the summer months similar results should be obtained from grain fed at the same rate on good pasture.

Gilts intended for the breeding herd can be fed the same rations as the sows in pig. They should be fed a sufficient amount of grain to ensure good growth and yet not permit them to get too fat. Many good gilts are spoilt by allowing them to get too fat. In general this can be effected on a ration of about 2-3 lbs. of grain per day per 100 lbs. live weight, which will usually work out at from 5-7 lbs. of grain per gilt per day.

Feed for Boar.—The boar may be fed the same ration as the breeding sows. He should be kept in good thrifty condition and not allowed to get overfat. In general about 3-5 lbs. of cocentrates per day, when he is not working, with somewhat more when he is in service, is sufficient. The boar should have plenty of exercise.

To ensure that the pigs receive sufficient minerals, they should have free access to a mineral mixture of bone meal 3 parts, salt 1 part. Some breeders add wood ashes or charcoal to this mixture.

Care and Feed of Sow and Litter at Farrowing.—Previous to farrowing, the farrowing pens or quarters should be thoroughly cleaned and disinfected. Unless a movable colony house in clean camps can be provided, the sows should farrow in proper pens with concrete floors, which can be kept clean and free from parasitic infection. As bare concrete floors are cold in winter and often damp in summer, a boarded section of floor on which the sow can farrow is a great advantage. A small quantity of short bedding should be provided, but, as a rule, the less bedding the better. The pen should be provided with a farrowing rail about 9 inches from the wall and 9 inches from the ground, to prevent the sow crushing the young pigs.

The sow should be removed to the farrowing pen a few days before it is due to pig. The Pen should previously have been scrubbed out with boiling water and caustic soda. The udder should be washed off once or twice with soap and water to remove worm eggs, and the sow groomed daily, if possible, to accustom it to handling. The ration should be made more laxative. At this time bran and ground nut cake are good feeds, as they tend to prevent constipation. A day or two before farrowing, cut the ration down to half. Green feed should be given freely if available.

If the sow farrows normally it should be disturbed as little as possible. Young sows sometimes require assistance, but amateurs often do more harm than good by handling the sow at this time, and experienced assistance should, if possible, be secured if help is needed. After farrowing, the after-birth and any dead pigs should be removed, and it is advisable to dust out the farrowing pen with slaked lime.

In the case of large litters, the number of surviving piglets should be reduced to ten or less if the sow has fewer teats available. Runts should be killed at this stage.

During the first day after farrowing the sow should be given no feed, but plenty of water to drink. In the cold weather this should be warmed. On the second day 1 lb. of grain should be given as a slop. This quantity should be increased at the rate of about 1 lb. per day to 4 lbs. at the end of the first week. During the second week the grain should be increased at the rate of ½-1 lb. per day until the

sow is on full feed. A rule often followed is to work up to 1 lb. per day per piglet in the litter.

The ration should be one to stimulate milk production, and the sow should be fed to the limit of its appetite. Sows which are good milkers and which have large litters can with advantage be fed three times a day. If the sows are indifferent milkers they will sometimes commence to put on weight after the fifth week. In this case their ration should be reduced sufficiently to maintain only their weights. Where possible, sows and litters should be fed individually. The common practice of combining several sows in one lot is usually productive of a large percentage of runts among the young pigs.

Good rations at such times are:—

1. Maize 1 part, separated milk 2 parts.
2. Maize 9 parts, meat meal 1 part.

Ground cowpeas or Kaffir beans can take the place of part of the protein supplements named. Oats, Kaffir corn, or other farm-grown grain can be substituted for part of the maize. Bran is a valuable feed at this time, and if available can with advantage make up a quarter of the grain ration for the first two weeks after farrowing.

If clean pasture is available, the sow and litter can be turned out to graze when the piglets are two or three weeks of age. If such pasture is not available, the sow and litter should be kept in a clean sty.

Three weeks after farrowing, the milk production of the sow usually reaches the maximum, and provision should be made to supplement the milk after this time. A good way to do this is by providing a grain ration for the young pigs in a creep or enclosure to which the sow cannot get. Shelled maize is a good feed to start the young pigs on; later they can be given some of the same ration as the sow. It is important that the young pigs should be eating grain before weaning. The pigs should be weaned at about eight weeks, depending on the condition of the sow and the quantity and nature of the feeds available for the young pigs after weaning. A few days before young pigs are taken away, the ration of the sow should be cut down and the proportion of protein

decreased to reduce the milk supply and lessen the danger of udder trouble after weaning. It is usually more convenient to remove the sow from the young pigs than to reverse the process. Weaning should be completed in one operation, and usually it should not be necessary to return any of the young pigs to the sow. Any abrupt change in the feeding of the weaners should be avoided at this juncture.

When the sow's udder has dried up, the ration should be increased to bring the sow into rapidly improving condition when put to the boar. This plan is based on the practice of "flushing" sheep and is conducive to the production of large litters. The best time to cull unsatisfactory sows is after weaning. All sows which are poor producers, bad tempered, clumsy or pig-eaters should be cut out. No market herd can be kept up to a high standard without constant culling. The minimum breeding standard should be the ability to wean six to eight healthy pigs. One of the most effective ways of reducing the costs of production is to raise large litters per sow.

Sows may be occasionally come on heat when nursing litters. It is usually inadvisable to breed them then. They should normally come on heat a few days after the litter is weaned. They should be bred then, as they hold to the boar most securely then, unless in low condition, when they should be given 4-6 weeks to recuperate.

Shade and Comfort.—During the summer pigs should have plenty of shade. Where natural shade is not available, artificial shelters should be erected. In the hot weather a wallow is of value to keep the pigs cool. A little dip or used motor oil should be poured on the surface occasionally to preserve it in a sanitary condition. The sleeping quarters should be dry.

In the winter the pigs should be protected from cold winds and draughts. The runs should be arranged so that the pigs can get in the sun when they want to. The sleeping quarters should be kept as free from dust as possible.

Particulars of buildings for the housing of pigs has been published in Bulletin No. 1169.

VETERINARY SECTION.

Good hygiene is as essential for the maintenance of health amongst pigs as it is for that of all animals. Unless they are kept under hygienic conditions and free from disease, either of an infectious or sporadic nature, they cannot thrive or reproduce to the best advantage. We are fortunate in Rhodesia in not having to contend against diseases such as hog cholero (swine fever), swine plague and swine erysipelas which are so prevalent in many other countries. Even our near neighbours in the Transvaal have with them an African type of swine fever which makes pig raising impossible in certain areas.

The absence of such diseases, however, should not in any way be regarded as a reason for failing to adopt the necessary precautions for preventing introduction of disease into one's swine herds; it should on the contrary serve as a stimulus to prevent and control those diseases which do exist, and to ensure that every effort be made to maintain the animals in perfect health.

There are with us, unfortunately, certain diseases which in far too many cases are responsible for failure in raising or marketing pigs, and it is the intention here to deal only with the most important of these conditions, which are not infectious diseases in the true sense of the term. Before dealing with them, however, it would be well to indicate briefly how to detect any deviation from normal health, and, when such departure is found, what points to pay special attention to in order to obtain information which will assist in arriving at a diagnosis and on which to base curative and preventive treatment.

Most pig breeders are familiar with the normal healthy habits of their stock, relying chiefly on their general appearance and activity, their appetite and the rate of growth or condition as a guide to their state of health.

A normal healthy pig appears alert, the eyes being clear and bright, the skin is clean, and, in young animals especially, has a gloss; notice is taken of any unusual sounds or movements and the animal is active and lively. Mature pigs are considerably less active than young ones, but nevertheless move about readily and are alert if disturbed. At

feeding time the animals crowd round and readily—even gluttonously—consume the food when it is given. Young pigs thrive and grow out very quickly on a proper ration, and condition is maintained and increased, the animal appearing well rounded off, the skin evenly and smoothly covering all seats of prominence or depression.

In cases of disease many or all of the above characteristics of the healthy pig, depending on the nature of the disease, are absent. Dullness and listlessness are in evidence in most cases. Movement may be difficult or impossible. The appetite is capricious or may be in abeyance; thirst is increased in most febrile diseases. In diseases which persist for even a few days there is loss of condition and an appearance of general unthriftiness, and if this continues emaciation may become pronounced. In digestive disturbances the act of vomition, or indications of it, may be observed, or there may be signs of diarrhœa or constipation.

In conducting a general examination particular attention should be paid to points such as the above before proceeding to the more detailed special examination.

In observing the symptoms of any disease it is necessary first to examine the animals without disturbing them. This is best done by remaining outside the sty and watching for several minutes—particularly at feeding time. When doing this, particular attention should be paid to the type of breathing of the animal, *e.g.*, whether normal, panting or deep, slow breathing, as this is masked when the pig is disturbed for closer examination.

Having obtained a good general impression of observable symptoms in this way, one should next enter the sty oneself and attempt to make the patient move round, or, preferably, get some one else to do this, and carefully note any peculiarities of movement, reluctance to walk or distress on walking.

One should next proceed to a closer examination of the animal. For such an examination it is necessary to have the patient caught and held securely by one or more assistants, but it is essential that the animal be dealt with carefully and not unnecessarily chased about. This examination includes taking the temperature—the normal varying from about 101 degrees F. in the morning to 103 degrees F., or even a few

points more, in the afternoon—observing more closely any abnormalities already detected, *e.g.*, any swellings or discharges, and noting any other points likely to assist in diagnosis, *e.g.*, the state of the breath and the colour of the mucous membrane of the eye and mouth.

Should an animal die a *post-mortem* examination should be made, unless there is any suspicion that the disease may be anthrax, in which case the carcase should on no account be opened, but a blood smear made, care being taken that as little blood as possible escapes from the incision, and veterinary advice immediately sought. When a large number of pigs are suffering from any disease it is advisable to slaughter one and carry out a *post-mortem* examination with a view to arriving at a definite diagnosis, and hence being able to institute effective treatment for the others.

A *post-mortem* examination to be of any use must be thorough and must be performed as soon after death as possible; this is particularly important, as putrefaction sets in very rapidly and masks any changes in the organs which might otherwise have been detected. In order to be able to observe any deviations from the normal it is necessary to have a good idea of the general appearance of organs of healthy pigs, and one is therefore well advised when slaughtering pigs for consumption to spend some time in studying the appearance of such organs as the lungs, heart, liver, spleen, kidneys, stomach and intestines. Being familiar with the normal fits one much better for distinguishing disease changes when these are encountered.

A *post-mortem* examination is not complete unless all the above-mentioned organs are examined, and, in the case of the stomach and intestines, these should be opened with a pair of scissors throughout their entire length. Many deaths are attributed to mysterious diseases when the owner himself, by opening the stomach and intestines, could easily have found the true cause in the shape of masses of round worms (*Ascaris*).

To adopt preventive or curative treatment without being able to diagnose the trouble is a most unsatisfactory, useless or even harmful procedure, and it is for this reason that some time has been spent on describing the essentials of clinical and *post-mortem* examination.

Measles (*Cysticercosis*).—The infestation of pigs with measles undoubtedly is responsible for the greatest number of carcases which are condemned as unfit for human consumption.

A measle (*Cysticercus cellulosæ*) is the cystic, bladder worm or development stage of the human tape worm (*Tænia solium*). The pig is therefore the secondary host, harbouring only the immature stage, of an intestinal parasite of man, who is the primary host.

The life cycle is passed through the following manner. Starting from the adult tape worm in the human intestine, eggs are produced and pass from the worm into the contents of the bowel, and are voided in the excreta. Such contaminated excreta may then be eaten by a pig, in which case the infective eggs on arrival in the stomach are acted upon by the gastric juices, the shell is dissolved and a minute parasite liberated. This embryo perforates the stomach wall, and, by migration into and transportation by the blood stream, arrives in the muscular system, where it undergoes further development, changing from the young embryo to a bladder worm (measle) stage. When fully developed and mature this is infective to man, and if the infested pig is slaughtered and the flesh containing the cysts eaten it develops further, becoming a tape worm located in the intestine. This matures and in turn develops eggs, and the life cycle is repeated.

The cyst may first be visible to the naked eye three weeks after becoming seated in the muscle. At this stage, however, it is easily missed. With development it enlarges, varying in size up to that of a small pea. It has a bladder-like appearance, light blue in colour and transparent with a white spot inside, which is the head of the future tape worm. The cysts are mature, *i.e.*, fully developed and infective, after three to four months' development. Sometimes even before this stage, or at a variable later period, they degenerate, becoming opaque and hard, in which case they are no longer infective.

No symptoms are observable in the living pig. Infection is only diagnosed when the muscles are cut open after death, with the exception of those rare cases in which the measle systs are visible on the under surface of the tongue. The

parts in which the cysts most commonly occur are the muscles of the tongue, neck, thigh, forearm, heart, diaphragm and cheek.

There is no method of destroying measles in a live pig. Treatment therefore being useless, preventive measures are all that remain. Fortunately, owing to the knowledge of the life history of the parasite, these are simple and completely effective, and consist of preventing pigs from eating infected human fæces, or food contaminated with such. Infected humans should be put under curative treatment, and the use of latrines be encouraged, and finally, infected carcases of pigs should be destroyed to prevent further infection of man.

Ascaris Suum.—This is the most harmful worm parasite of pigs. Its habitat is the small intestine, and in this position sometimes hundreds may be found. It is a large worm, light cream in colour, five to eight inches long and about the thickness of a clinical thermometer or its case. No intermediate or secondary host is required for the life cycle. Eggs laid by the female parasite in the intestine pass out with the fæces, and under favourable conditions of warmth and moisture the embryos, still in the shell, develop on the ground to an infestive stage in ten to fourteen days. Such eggs are very resistant to unfavourable influences, such as frost, drying and even ordinary disinfection, being stated to remain infective for up to five years or more. Such a ripe egg when ingested by a pig is acted upon by the gastric juices, and the larva is liberated in the stomach. The larva now bores its way into a blood vessel, and is carried to the liver, and thence to the lungs, where further development occurs. From here it passes into the bronchi, up the wind pipe, is coughed out through the larynx, swallowed and passes again into the stomach and into the intestine, where it matures. The period of migration occupies about ten to twelve days.

The symptoms are variable on account of the complex development of the parasite. Their presence in the lungs frequently causes pneumonia in young pigs, the symptoms then being dullness, loss of appetite, difficult breathing and a cough. Death may result from a severe lung infection in one to two days. Where infection is less severe the young

pigs are stunted and unthrifty, and show symptoms of coughing and difficult breathing. The cough may improve, and the only persistent symptoms are those of unthriftiness and distressed breathing (snuffles). Weaners may show the above symptoms, but usually the symptoms are more indefinite, the animals being stunted, pot-bellied and weak in spite of good food. Sometimes convulsive fits occur at feeding time. Symptoms are most pronounced in young pigs; adults may show a slight cough and lose condition. *Post-mortem* appearances depend on the symptoms noticed, *e.g.*, pneumonia, when the young pigs die as a result of acute infection. Where the disease has persisted for a fortnight or so the mature worms are found in the intestine, and here there may be noticeable ulcers and hæmorrhages.

Treatment is only recommended in conjunction with prevention. It is no use allowing treated animals to remain on infected ground, especially when it is realised that the ripe eggs are so resistant. It consists of starving the animal for 24 hours and then drenching it with chenopodium oil and castor oil at the rate of 1 c.c. of the former and 8 c.c. of the latter for every 25 lbs. body weight. These drugs may be given in a little bran or mealie mash, but are then less reliable. The pigs may be fed as soon as the purgative has acted.

Prevention varies according to circumstances. Where infection does not already exist care should be taken to prevent its introduction, *e.g.*, by procuring pigs from a known clean area, or, if any doubt exists, even these should first be freed from all infection by treating as above.

On infected farms the pigs may be moved to an area previously kept free, taking precautions to treat them before removal. If this is impracticable, a sow should be thoroughly scrubbed and washed immediately before farrowing to clean her skin of eggs which may be present in the adhering dirt. She should be placed in a farrowing pen which has been previously cleaned with boiling water and caustic soda. After farrowing the sty should be cleaned regularly and thoroughly, the dung being removed daily, all bedding every few days, and at least once a week the floor should be scrubbed. After weaning, the litter should be maintained under clean conditions and not be allowed access to contaminated places.

Their food and water should also be free from contamination, e.g., green stuff should not be collected from areas grazed in by other pigs, water should be fresh and from a clean source, etc.

To reduce further the possibility of infection being conveyed from the sow to her next litter, she should be treated to free her from worms immediately after weaning the litter and again about 8-10 weeks after service.

Scours (*Diarrhœa*).—One of the most common conditions causing serious losses in sucklings is scours. The cause can usually be traced to unsanitary conditions, wrong feeding or intestinal parasites. The feeding of the sow on mouldy or fermented foods, excessive maize, at irregular periods or suddenly changing her diet are frequently responsible for scours of sucklings. Diseases of the udder or infectious diseases of the sow are also manifested as scours in her litter. The symptoms are obvious. The fæces are fluid or pasty, frequently voided, light coloured and foul smelling, and the tail and hindquarters are soiled. Death may occur early or the disease may persist with marked loss of condition.

In weaned and older pigs the condition is also due to similar causes, bad and wrong food being the usual, if infectious disease and parasitism are excluded.

Treatment consists of removing the cause, *i.e.*, the food, and hygiene should be immediately corrected. A purgative, castor oil, should be administered with a view to eliminating the irrating substance; in the case of sucklings the sow should receive the treatment. If the condition still persists, lime water given with the food in doses of 5 to 10 ozs. is said to be effective. Should parasites be responsible, the animals should be treated as recommended for ascaris infection.

Constipation.—This is usually the result of too concentrated foods, especially in conjunction with limited exercise. The food should therefore be corrected and provision made for sufficient exercise.

If the condition is acute an enema should be given. Purgatives, such as castor oil, linseed oil, or epsom salts, are also useful.

Pregnant sows should be allowed 3 ozs. of linseed oil daily in their slop feed as a preventive.

Southern Rhodesia Veterinary Report.

MAY, 1941.

DISEASES.

No fresh outbreaks.

TUBERCULIN TEST.

Thirty bulls, 48 cows and heifers and 3 calves were tested on importation. There was one reactor.

MALLEIN TEST.

Four horses were tested with negative results.

IMPORTATIONS.

Union of South Africa.—Bulls, 30; cows, heifers and calves, 50; sheep, 726; horses, 2; pigs, 2.

South West Africa.—Cows and calves, 5.

Bechuanaland Protectorate.—Slaughter cattle, 552; sheep and goats, 987; pigs, 25.

Northern Rhodesia.—Horse, 1.

United Kingdom.—Horse, 1.

EXPORTATIONS.

Portuguese East Africa.—Slaughter cattle, 120.

Union of South Africa.—Horses, 2.

Northern Rhodesia.—Sheep, 100.

EXPORTATIONS.—MISCELLANEOUS.

In Cold Storage.

United Kingdom.—Beef quarters (chilled quality), 3,978; tongues, 7,228 lbs.; livers, 43,143 lbs.; tails, 5,627 lbs.;

skirts, 3,600 lbs.; tongue roots, 3,147 lbs.; hearts, 2,350 lbs.; cheeks, 2,822 lbs.; fillets, 898 lbs.

Northern Rhodesia.—Beef carcases, 253; mutton carcases, 44; pork carcases, 25; offal, 11,002 lbs.

Belgian Congo.—Beef carcases, 145; pork carcases, 100; offal, 638 lbs.

Meat Products from Liebig's Factory, West Nicholson.

Union of South Africa.—Corned beef, 572,868 lbs.; tongues, 676 lbs.; beef and vegetable rations, 202,902 lbs.; ideal quick lunch, 19,560 lbs.; Vienna sausages, 3,810 lbs.; meat paste, 2,267 lbs.; beef fat, 58,000 lbs.; beef rolls, 1,686 lbs.

Northern Rhodesia.—Meat paste, 2,000 lbs.; bonemeal, 2,400 lbs.

Belgian Congo.—Bonemeal, 12,000 lbs.

Bechuanaland Protectorate.—Bonemeal, 2,000 lbs.

Tanganyika.—Corned beef, 1,080 lbs.; tongues, 36 lbs.; Vienna sausages, 150 lbs.; ideal quick lunch, 24 lbs.; beef and ham rolls, 144 lbs.; meat paste, 117 lbs.; beef rolls, 192 lbs.; cocktail sausages, 145 lbs.

Kenya.—Corned beef, 3,960 lbs.; tongues, 684 lbs.; Vienna sausages, 660 lbs.; ideal quick lunch, 576 lbs.; meat paste, 380 lbs.; beef rolls, 702 lbs.; cocktail sausages, 570 lbs.; pate de foie gras, 161 lbs.

Portuguese East Africa.—Corned beef, 720 lbs.; tongues, 252 lbs.; Vienna sausages, 563 lbs.; ideal quick lunch, 24 lbs.; meat paste, 29 lbs.; beef fat, 600 lbs.; Cambridge sausages, 120 lbs.; Oxford sausages, 120 lbs.

C. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA
Locust Invasion, 1932-41.

Monthly Report No. 102. May, 1941.

Red Locust (*Nomadacris septemfasciata*, Serv.)—Numerous reports of winged swarms have been received during May, the following districts being involved, namely, Lomagundi, Darwin, Mazoe, Mrewa, Mtoko, Inyanga, Marandellas, Salisbury, Hartley, Charter, Melsetter, Ndanga, Chibi, Gutu, Chilimanzi, Gwelo, Selukwe, Belingwe and Bulawayo. The reports refer mainly to "large" and "very large" swarms.

It appears that there are considerably more locusts in the Colony than has been the case at this time of year since 1934.

The general trend of flight has been more or less westerly. There is no doubt that the majority of the swarms originated on the low veld to the east and have gradually infiltrated into the Colony. In the area indicated there has been an exceptionally low rainfall in many parts during the past season, which may have favoured successful breeding.

In any case the prospects for next wet season must be regarded at present as unfavourable.

RUPERT W. JACK,
Chief Entomologist.

IMPORTANT NOTICE

FERTILISER SUPPLIES

With reference to Government Notice 304 of 1941 appearing in the Government Gazette on Friday, 4th July, 1941, all farmers who have placed orders with the fertiliser firms in terms of Notices which appeared in the press requesting them to do so on or before 31st May, 1941, are now requested to confirm these orders and further to take delivery of their purchases at the earliest possible date in order that storage accommodation, which will thus become available, may be utilised for the storage of any further supplies which may be procurable.

Orders for any additional amounts of fertilisers which may be required for the season 1941/42 should be placed with the fertiliser firms before the 15th August, 1941.

D. H. TOBILCOCK,
Secretary, Ministry for Co-ordination.

P.O. Box 1281, Salisbury,
30th June, 1941.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

THE RHODESIA Agricultural Journal

Vol. XXXVIII.] No. 8 [August, 1941

Editorial

Notes and Comments

Camp Sites: Rhodes Inyanga Estate.

Four rest camps have been built, two in the neighbourhood of the Pungwe Falls, one at the Nyamziwa Falls and one near the Rhodes Hotel, and they are available for short time occupation by the public. The Pungwe camps are situated at a distance of thirteen miles from the hotel and are adjacent to the Inyanga-Umtali Road. The Nyamziwa camp is seven miles to the north of the hotel.

Each camp consists of a detached kitchen and store of brick under iron and a block of three rooms of brick under thatch. The kitchen is provided with a stove and a table. The living rooms are furnished with four beds and mattresses, one dining table, two bedside tables, six stools or chairs, one washstand and basin, and one hurricane lamp.

Camps are in charge of a native, who will provide the necessary wood and water, but who is not expected to perform any other services for campers.

The rent payable will be 5s. per twenty-four hours or part thereof, or 30s. per week. Camps may not normally be hired for more than fourteen consecutive days by any one party.

Application for the hire of a camp should be made at least fourteen days in advance to the Manager, Rhodes Inyanga Estate, P.B. Rusape, and for a definite period.

Payment for the whole of the proposed period of occupation must be made in advance, but should not be effected until advice has been received that a camp will be available for the period required. Tickets will be issued which should be handed on request to the native in charge of the camp.

Campers will require to provide all camping equipment which they may consider necessary, other than that mentioned in paragraph two above.

A lorry service from Umtali and Inyanga passes within one mile of the Pungwe camps, leaving Umtali on Thursday and returning on Fridays.

The R.M.S. lorry from Rusape arrives at the Rhodes Hotel on Mondays and Thursdays at about 2 p.m., leaving again for Rusape on Tuesdays and Fridays at about 10 a.m.

Treatment of Tobacco Seed—Chemistry Branch.

The Chemistry Branch is prepared to carry out, as far as possible, the cleaning and treatment of tobacco seed during the coming season, but as the Branch is suffering from shortage of staff and pressure of other duties, tobacco farmers are earnestly requested to forward their seed as early as possible, as the treatment will be carried out in strict rotation; lack of staff may mean that seed sent in late in the season cannot be dealt with by the Branch.

No seed will be accepted for treatment after 30th September.

Potash from Plant Ash.

As the war continues the difficulty of obtaining adequate fertiliser supplies increases, and particularly is this the case with potash. It is therefore of interest to know that the ash from plant residues normally burned on the land is a valuable source of this ingredient. Recent analyses by the Division of Chemistry show that the ash of tobacco stalks contains about 30% K_2O and of sunflower stalks 20%. Scrap tobacco ash has also about the same content. The ash from 100 lbs. of stalks varies from about 10-15 lbs. It is therefore seen

that the ash from 500-700 lbs. of stalks would supply approximately the same quantity of potash as 200 lbs. of a standard tobacco fertiliser. In addition, such ash contains an appreciable quantity (about 20%) of lime and 1-3% phosphoric oxide. These analyses show that it would be worth while to collect such stalks and ash them carefully, so that the ash may be used to the best advantage in making up any deficiency in potash.

Wintersome.

With the increasing popularity of this crop, particularly the grazing of ratoon growth, it became necessary to ascertain if, in common with other sorghums, it contained harmful quantities of cyanogenetic glucosides which yield prussic acid. Accordingly a small plot was planted adjoining the Chemistry laboratory and analyses carried out during the year. The results of these were as follows:—

Full grown, well developed plants: No prussic acid.

Wilted plants: No prussic acid.

Stunted plants: 1.6 grains prussic acid per lb.

Ratoon growth after cutting main crop: 2.2 grains prussic acid per lb.

Authorities state that about 20 grains prussic acid is the minimum fatal dose for cattle, so that 10 lbs. material would provide a dangerous feed. Other factors, however, have to be taken into consideration. (1) The amount of prussic acid present varies considerably according to climate and soil conditions. (2) The concentration of the acid after eating depends on the rate the plant was ingested. (3) In the stomach the gradual evolution of the acid from the plant leaves time for its elimination with consequent diminution of the total effect.

It is known that some farmers have allowed stock to graze wintersome without any ill effects. Nevertheless in consideration of the above factors this crop must be regarded with suspicion and precautions taken accordingly. When converted into silage wintersome is harmless. It should be noted

that sorghums cross-pollinate very readily, so that care should be taken to maintain the purity of wintersome and avoid crossing with other sorghums which are known to be more toxic.

Weevils.

A review, by the Entomologist of the Fiji Department of Agriculture, of an important article on grain weevils written by three Australian Entomologists closes with the following paragraph:—

"All this goes to show that the key to weevil control, where large quantities of grain are stored, is thorough cleanliness throughout. Were a more attractive or novel remedy suggested people would be more likely to carry out the measures than where they are routine, irksome and non-spectacular."

Whilst the last sentence is a severe criticism of humanity in general, we are afraid it is true. But it is notable that those who truly recognise the aid of cleanliness in insect control apply its principles almost with the zeal of a fanatic —and get results.—*Cleanliness Aids Insect Control.*

Fertiliser and Cleanliness.

The large proportion of potash and other fertilisers in ash obtained by burning tobacco refuse, as shown by tests made in the Department's chemical laboratory in Salisbury, makes good reading from the fertilising point of view. From the point of view of pest control by cleanliness, the vexed question of the destruction of refuse for field sanitation purposes diminishes.

In terms of the Tobacco Pest Suppression Act, all stalks and roots of tobacco must be *removed* from the lands and *destroyed* by 1st August each year, with the exception of Turkish tobacco, which must be removed and destroyed by 1st September. The main choice of methods of destruction lies between burning and conversion into manure (ploughing in being illegal).

Burning is a speedy and deliberate process requiring little more than the transport of the refuse to the edge of the land and the subsequent application of a lighted match or fire-brand. Composting, on the other hand, is slower, and usually requires considerably more transport, whether of crop refuse or of water. Delaying composting until the rains have set in is a dangerous and illegal practice. The result is that the majority of growers now burn their tobacco refuse. They have the feeling that it is the only safe method, but this feeling is tempered with a certain measure of regret because of the apparent waste, for often the piles of refuse are small and the ash is left to the mercy of the elements.

But now, those growers who need to burn because their local conditions do not favour economic composting of tobacco refuse can feel that they are receiving more than the already generous wages paid by cleanliness, by reason of the added recovery of fertiliser.—*Cleanliness Aids Insect Control.*

Letters to the Editor.

A correspondent, "Three Score and Five," writes to congratulate us on the editorial note on Veld Burning in the June issue and comments further as follows: "I would like to add a bit more on the advantages of *controlled* veld fires. (1) It kills thousands of thorn trees coming up, which on my farm are destroying my good grazing. (2) It kills millions of ticks living in parts where cattle cannot graze, such as unfenced farms. (3) I believe it purifies the veld from germs, etc., that cause contagious abortion, quarter evil, foot and mouth and other diseases."

In reply we wish to point out that the Department has never opposed *controlled* burning. Our propaganda is directed against *uncontrolled* grass fires which result in large areas of the country being denuded of vegetation. We agree that there are occasions when the burning of grass is essential, but we do consider that regular burning each year is both unnecessary and harmful. Farming practice should be so organised that the amount of veld burning necessary is reduced to a bare minimum.

On the subject of Soil Erosion, "Three Score and Five" writes: "I have time and again made drains to carry off flood water and they always get choked up with grass and weeds growing in them and diverting the water elsewhere. Similarly with sluits in the veld; time and again I have seen big ruts washed out after a big thunder shower. In a year or two these sluits are overgrown with weeds or grass and the water brings down branches, etc., to block them up. The water then washes new sluits and so it goes on, nature provides. Most sluits are on the slopes of hills and the water spreads over the level country below. The slush and mud dam up against the grass and in time the level parts have an overburden of deposit. I would like to ask those experts who want every farmer to dam all the sluits what it will cost to make dams to hold the water after a 4 to 7 inches rain in one day such as I have often seen."

The Soil Conservation Officer comments as follows:—

"Natural drainage channels should be left as such and generally no attempt made to divert water out of them or dam up storm water in them, except for specific purposes such as irrigation.

"Check dams in sluits are intended to reduce the speed of the water sufficiently to permit of the establishment of vegetation. Expensive masonry check dams are only recommended when the erosion is so serious or the flow so great that pole and brush check dams would not achieve the above object. These are made only high enough to reduce the speed of the water. Pole and brush check dams are usually only 4 to 6 inches high. Their object is to assist nature in the revegetation of the gully.

"If sluits and drains are becoming choked the fault usually lies in erosion or denudation above. A light cover of weeds will not seriously interfere with the flow in correctly made and graded storm drain of adequate size. Deposition of silt on a level land is usually detrimental and moreover denotes serious erosion above. It would appear that your sluits and drains are receiving large volumes of silt charged water, perhaps due to reduction in cover on the hillsides. Breaks in drains may be due to insufficient size, attempts to divert natural channels, heavy silt load, incorrect gradient (e.g., too steep or too gentle) or the uppermost drain may be too far down the slope, or the drain may have become choked with trash, branches, etc.

"No 'expert' has made the recommendation that sluits should be dammed so that all storm water is held up. It has been recommended that more water might be held up where it falls by soil conservation, controlled grazing and controlled burning, so that it can be of benefit, and harmful floods would be reduced in intensity."

First Grade Cream.

HOW TO PRODUCE IT.

1. Milk in clean, dust-free surroundings.
2. Wipe the cow's udder and teats with a clean wet cloth before milking.
3. See that the milker washes his hands before milking each cow. Provide running water for this, *i.e.*, a drum of water fitted with a tap.
4. Use cow hobbles to tie the cows' hind legs—not reims.
5. Feed dry, dusty feeds such as hay, *after* and not before milking.
6. Do not permit wet milking—use a lubricant such as vaseline if this is necessary.
7. Strain the milk through a proper strainer with a cotton wool filter pad.
8. Separate the milk into clean, sterilised receptacles.
9. Cool the cream as it leaves the separator—use a cream cooler for this purpose.
10. Do not mix warm and cool cream.
11. Stir the cream three times a day, using a *metal* cream stirrer.
12. Keep the cream cool pending despatch to the creamery.
13. Do not place warm cream in a refrigerator—cool it first.
14. Send the cream at least three times a week to the creamery.
15. Always *fill* the can.
16. Separate a cream testing about 40-45 per cent. of butter-fat.

17. See that all utensils are properly cleaned and sterilised *immediately* after use by:—

    (1) rinsing at once with cold water;

    (2) scrubbing with hot water, cleansing powder and a brush;

    (3) rinsing with hot water;

    (4) steaming at 200° F. for at least 20-25 minutes.

    Then place the hot utensils upside down on a rack in the dairy. Clean your cans in this manner immediately they come back from the Creamery.

18. Do not use cloths or soap for cleansing dairy utensils.

19. Do not forget that at present prices the difference between First Grade and Third Grade on a 3 gallon can of cream amounts to about 4s. Why throw this money away?

Our Creameries need more First Grade Cream, so hang this leaflet in your dairy as a reminder.

TIME, GENTLEMEN.

Clickety clickety clock!
The weevil ran up the shock.
She laid some eggs and then ran down
And ran up another shock.

Now this was a nasty knock
For the farmer who owned the shock.
For every time she ran up and down,
The weevil increased her flock.

This shocking state of affairs could be improved by agricultural and store cleanliness, for—

Cleanliness Aids Insect Control.

Trypanosomiasis or Tsetse Fly Disease.

By D. A. LAWRENCE, B.V.Sc., Director of Veterinary Research.

The object of this article is to assist those stockowners living in or near the tsetse fly belt in preventing losses from the disease transmitted by these flies, by supplying information on its prevention, recognition and treatment.

Trypanosomiasis is a specific disease caused by minute living organisms, "trypanosomes," invading and developing in the animal body. It is commonly referred to as "fly," "tsetse disease" or "nagana," and infected animals are described as being "fly-struck."

The association between the disease trypanosomiasis and the tsetse fly has long been recognised—Livingstone gave a good description of the disease in 1857 and never doubted then that it was associated with the tsetse, and in 1894 Bruce proved conclusively that the tsetse fly was the transmitter of the infection. Since then many investigators have confirmed that the common trypanosomiases of man and animals in South and Central Africa are transmitted by tsetse flies. All investigators agree that these flies are the main vectors, but there are a few who maintain that other biting flies can also convey the disease from sick to healthy animals mechanically, *i.e.*, without the trypanosomes multiplying in the body of the fly as occurs in the case of the tsetse fly. This may possibly be correct, particularly in the case of *T. vivax* infection, but the extent to which it occurs must undoubtedly be extremely limited, and it can safely be said that ordinarily every outbreak of trypanosomiasis is associated with the presence of tsetse flies, *i.e.*, of course, with reference to the type of infection with which we are concerned in this country and which is caused by *Trypanosoma congolense*, *T. vivax* and rarely also *T. brucei*.

For trypanosomiasis to occur, therefore, three factors are essential, *viz.*, the causative organism (trypanosome), the transmitter (tsetse fly), and the susceptible animal (cattle, equines, dogs, etc.), and the only way of preventing such a disease lies in removing at least one of these factors, or, at any rate, in preventing them from coming together. For example, if one could do away with the trypanosomes the tsetse flies would not be able to acquire the infection with which to infect stock, or, if the tsetse fly were eradicated, the trypanosomes could not then spread from the sick to susceptible stock, and finally if there were no susceptible stock no infection could occur.

Any preventive measures must, therefore, aim at bringing about one or other of the above conditions. How can this be achieved? Firstly, let us consider the possibility of doing away with the trypanosomes. By treating infected stock in the manner to be described later, the trypanosomes in them can be reduced or destroyed. This certainly will decrease the chance of more tsetse flies becoming infected by feeding on such stock; but it cannot bring about the destruction of the trypanosomes in flies already infected, nor in carriers of trypanosomes other than domestic stock, *e.g.*, game.

The next weak link in the chain is the transmitter, *i.e.*, the fly. Considerable progress in the control of tsetse flies has been and continues to be made, *e.g.*, by controlling the animals (game) on which they depend for their food supply, by destroying the breeding and feeding haunts by bush clearing and by trapping. But it is difficult to say whether any or all of these methods will lead to their total eradication, and it is certain that such a result cannot be achieved in a short time.

Finally in this connection, there is the question of preventing infection by eliminating the susceptible stock factor. To render stock insusceptible means immunising them. This was attempted by Bevan, both while he was Director of Veterinary Research and again on his return to this Colony as Beit Research Worker in Trypanosomiasis, but a method suitable for practical application in the field was not discovered. At the present time, therefore, it must be admitted that there is no satisfactory method of rendering

stock insusceptible. It is not possible to say that a method of immunising animals against the various trypanosomiases will never be evolved, but research to date has shown that an animal successfully immunised against one species of trypanosome is still susceptible not only to other species but even to other strains of the same species—a difficulty which at this stage of our knowledge appears to be insurmountable.

From the above it is obvious that we are not at present in a position to eliminate any one of the factors essential to the propagation of the disease, and so the only means at our disposal of preventing infection lies in stopping, as far as possible, the factors from operating together. In other words, preventive measures that can be practised by the stock owner should consist of:—

1. Keeping main herds away from the feeding haunts of the fly, *e.g.*, in open country and away from heavily wooded rivers such as those running into Portuguese East Africa.

2. Reducing infection in the animals and thus reducing the chances of more flies becoming infected, *e.g.*, treating infected stock, thereby, at the same time, preventing their death.

3. Maintaining affected animals in a separate herd with the object of (*a*) keeping them as far from "fly" as possible and thus giving effect to 2 above, (*b*) giving them better attention and so increasing the chances of recovery, and (*c*) eliminating that possibility of biting flies other than tsetse conveying infection mechanically from them to healthy stock.

Recognition and Treatment.—The next point to be considered in preventing losses is that concerning curative treatment of the animals that have become infected. As with all diseases, to be successful treatment is dependent upon accuracy of diagnosis. The only certain way to diagnose trypanosomiasis is by demonstration of the actual causal organism, the trypanosome, with the aid of a microscope. Farmers cannot undertake this method of diagnosis themselves, but in those cases in which the existence of infection in a herd, or in an area, has been confirmed microscopically through blood smears, a

reasonably certain diagnosis can be made by the farmer from the general symptoms exhibited by infected stock. The symptoms vary somewhat according both to the species of animal infected and the species of trypanosome producing the disease and will only be dealt with on broad general lines. There may be variations even within the same species of animals, *e.g.*, better bred animals appear to be more susceptible than others and it is not uncommon, therefore, for the bull to show symptoms first in the herd. The incubation period, *i.e.*, the time that elapses between the biting by the fly and the development of the first symptoms is usually about 7-10 days, but although after such a period there is a rise of temperature and trypanosomes can be detected in smears, this first stage is rarely detected and it is not uncommon for the affected animal to remain apparently healthy for 2-3 months, or frequently until the onset of cold weather, before the first pronounced symptoms are noticed.

detected and it is not uncommon for the affected animal to remain apparently healthy for 2-3 months, or frequently until the onset of cold weather, before the first pronounced symptoms are noticed.

The animal then presents the general appearance of a sick beast, showing listlessness, lagging behind, drooping ears, rough coat, etc. As the disease progresses there is loss of condition, paleness of the normally pink membranes inside the eyelids, mouth and nostrils, weakness of the hind quarters, which may develop into complete paralysis, and frequently there is an affection of the eyes which gives them an inflamed appearance and causes a discharge of pus-like material. In certain cases swellings appear on the lower parts of the body, *e.g.*, limbs and belly. Loss of condition progresses until a state of absolute emaciation is evident, and towards the later stages of the disease there is usually pronounced diarrhoea which may even be bloodstained. During the course of the disease there are periods of high temperatures alternating with normal temperatures, and it is during these periods of fever that blood smears are most likely to contain the trypanosomes. At other times blood smears may be negative, hence a negative report on a smear from an animal suspected to be infected does not prove that it is not infected. For this

reason, where trypanosomiasis is suspected, it is advisable to send smears at the same time from a number of the animals or from the same few animals every alternate day for 10 days.

The course of the disease also varies considerably, depending again both on the species of animal and the species of parasite. In cattle it is usually long, *i.e.*, chronic, whereas in dogs and horses it is often quite acute.

Occasionally even untreated cattle may remain infected for months or years without succumbing, sometimes even without showing definite symptoms. Then there are cases which show symptoms and apparently recover after treatment and yet go down periodically to attacks of the disease in spite of being removed from a fly area.

It will be seen therefore that recognition of the disease, without resort to the microscope, may be difficult if not impossible, but the guiding factors in a fly area should be irregular temperature rises, droopiness, staring coat, anaemia, emaciation and weakness.

Treatment.—In considering treatment it must be realised that the drug administered only produces its effects as a result of its interaction with the parasite and the animal, and it is therefore most important that the animal should be assisted generally in the way of management if cure is to be hoped for. This means provision of adequate food and rest and exposure to a minimum of hardships. The ways in which this may be achieved are too numerous to detail, but as examples may be cited the following:—

(*a*) Keep the animals in a comparatively restricted area where there is good grazing and if necessary supply supplementary nutritious food.

(*b*) Do not drive them long distances—if the distance to the dipping tank is more than a couple of miles, have them rounded up the day before so that they will not be subjected to the strain of a long walk as well as to that of the actual dipping.

(*c*) Working oxen must be rested until they have recovered and regained condition.

(*d*) On those days when the injections are given, handling should be carried out with as little excitement, disturbance or "rough handling" as possible. A collecting pen with a race, crush, squeeze or grip will eliminate chasing the animals about, and if the animal has to be cast for the operation it should be done gently as described later. The animals should not be heated or tired, but should be collected the evening before, if necessary, and treated in the early morning while it is cool. Nor should they be exerted by a long walk immediately after treatment.

Several drugs have been recommended by different authorities in various countries for the treatment of trypanosomiasis, but for our purpose only two need be considered in connection with cattle. There are tartar emetic (potassium antimonyltartrate) and antimosan. Tests were carried out under field conditions some years ago in the Golden Valley area to ascertain the comparative curative efficacy of these drugs and these showed that there was virtually no difference in this respect. There are, however, great differences in cost and ease of administration. Tartar emetic is far cheaper—3d. per dose when obtained from this Department in sterile solution ready for use, and even less if the solution is prepared by the stock owner, as against about 1s. 10d. per dose for antimosan—but it must be injected intravenously (into a vein), its administration therefore being considerably more complicated than in the case of antimosan which can be injected subcutaneously (under the skin). Reports have at times been received indicating that, possibly owing to peculiar local circumstances, tartar emetic has proved less safe than antimosan in certain cases, and although no definite experimental evidence is available to verify or disprove this, it is a point that should also be considered when choosing what drug to use, and it may be advisable to select antimosan for use on valuable individuals such as bulls.

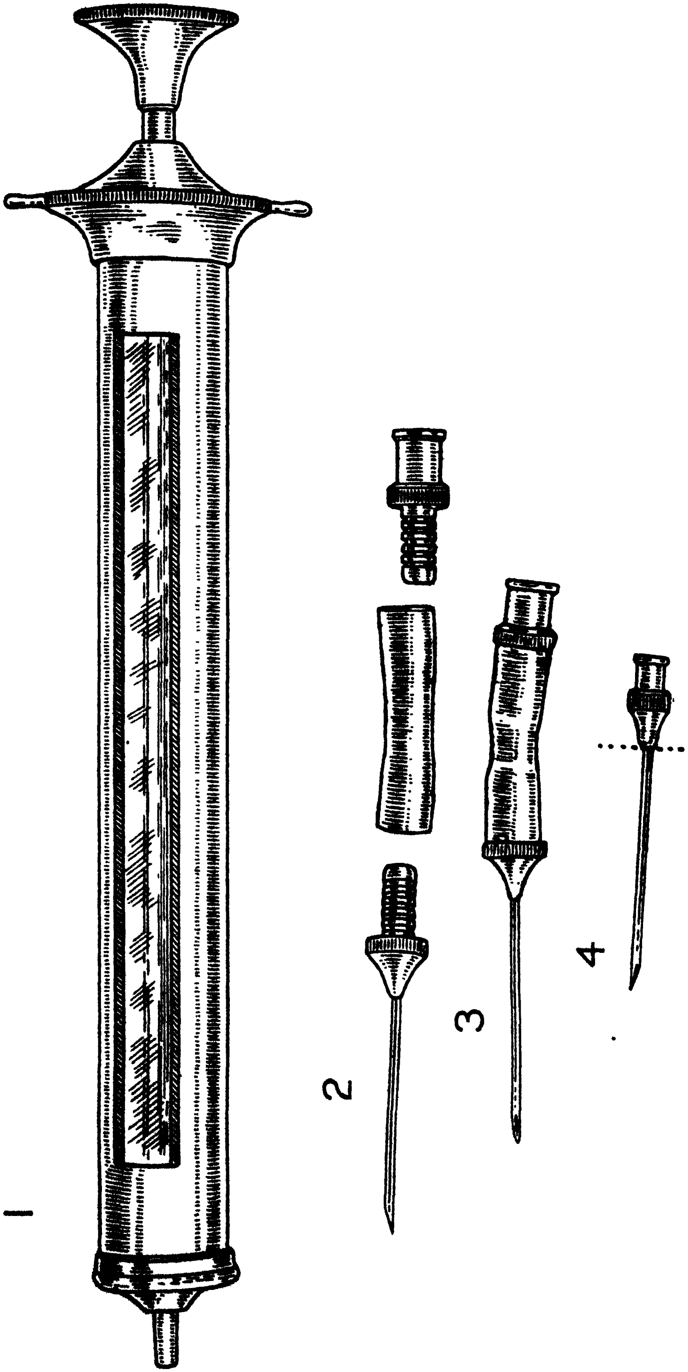
Antimosan is only procurable in solution ready for use and tartar emetic solution ready for use can also be obtained from this Department, but many people prefer to decrease the cost by purchasing the tartar emetic powder and making

up the solution themselves. There is no objection to this provided the solution is correctly prepared, *i.e.*, in respect of strength, purity and sterility.

How to Prepare Tartar Emetic Solution.—The correct dose per beast is 1 gram of tartar emetic dissolved in 25 c.c. of pure water. Most farmers have not sufficiently accurate balances to weigh out such small quantities and they should therefore purchase the drug in 1 gram packets. Only distilled or good clean rain water should be used for making the solution, and owing to difficulty in maintaining sterility the solution should be prepared freshly each time. In other words, only make up sufficient solution for the number of animals to be treated on any particular day. Measure off the amount of water required (25 c.c. for each dose) and boil in a clean lidded vessel, *e.g.*, an undamaged enamel pot with a good lid, for 15 minutes and add the correct number of 1 gram powders (1 for each dose), and when these have been dissolved allow the solution to cool, keeping the lid on all the time. When cool this solution is ready for use, and may be poured into a previously well boiled bottle, the cork of which must also have been boiled. Pouring should, of course, be done under dust-free conditions, and if a funnel is used this must also have been boiled.

As both tartar emetic solution and antimosan have to be administered by injection a word on sterilising the injecting equipment (syringe and needles) will not be out of place here.

Most syringes are supplied in metal containers with lids, and these containers serve very well as vessels in which boiling of the equipment can be carried out. Before putting a syringe in to boil see that it and its needles and attachments are clean and in good working order. Then, in the case of syringes with rubber plungers slacken off the plunger adjustment and the collar which holds in the glass barrel, and for metal plunger syringes remove the plunger from the barrel altogether, as otherwise the glass would be cracked owing to the greater expansion of the metal plunger during heating. Place the syringe, needles, etc., in cold water in the vessel and boil for 10-15 minutes, then pour off the water and allow the equipment to cool while still in the closed sterilising container. When cool, adjust, or for metal plunger syringes



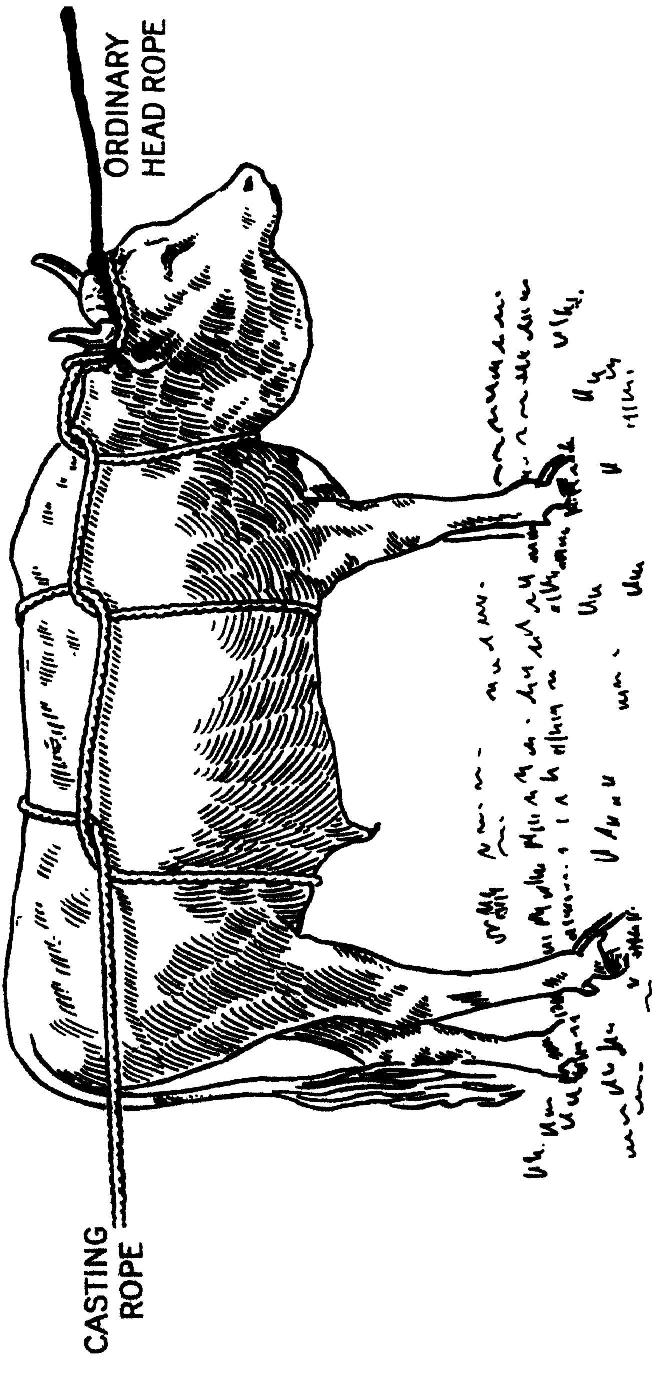
1. A 50 c.c. rubber plunger syringe.
2. Component parts of needle for intravenous injection showing needle, rubber tubing and adapter.
3. The parts assembled ready for use.
4. The dotted lines indicates where an ordinary hypodermic needle should be cut for the base to serve as an adapter.

reassemble, taking care that those parts which will come in contact with the drug are not contaminated through handling, etc.

How to give the Injection.—Operations of any type whatsoever are largely dependent for their success on adequate control of the animal. Accidental damage to personnel, equipment or the animal is almost invariably due to insufficient or imperfect securing of the beast. The operation of giving an injection is not only greatly facilitated but also likely to be more successful if the animal is under proper control, and in such a case the animal is not subjected to any excessive strain or unnecessary rough handling. It is quite unwarranted to "throw" a beast for a subcutaneous injection, nor is it necessary in the majority of cases to throw for intravenous injections. All that is required is a suitable type of crush, race or grip, in which the animal can be secured. In the case of an intravenous injection the only feature of importance in any crush is that the greater part of one side of the neck must be exposed in order that one can get at the vein without being hampered by the bars of the crush.

Where a beast must be thrown, throwing should be done humanely. For this a 30 feet length of $\frac{3}{4}$ inch cotton rope is the best. The animal should be secured first with an ordinary headrope or reim—if necessary to a tree or post—then the casting rope is applied as shown in the diagram, *i.e.*, with the noose round the horns, then in a series of half-hitches round the neck, chest and flank regions. The loop round the neck can usually be dispensed with without any disadvantages. Direct pulling backwards on this rope causes the animal to go down gently—it may stagger backwards for a yard or two first, hence, if it were originally tied to a tree, it is necessary to loosen the ordinary headrope before pulling on the casting rope. As soon as it goes down the head should be held to the ground and the legs secured by soft strong, leg ropes or reims, the animal being pulled over flat on its side.

A subcutaneous injection presents no difficulties whatsoever. All that is necessary is to pick up a fold of loose skin, *e.g.*, on the side of the neck or dewlap, and push the needle through the skin so that its point and front part lie



The method of applying a rope to cast an ox. The half-hitch round the neck is often dispensed with, the first loop then being round the neck.

freely under the skin, attach the syringe, which has been previously charged with the correct dose, and inject, and then pull out the needle, still attached to the syringe, and gently massage the swelling produced by the injected fluid.

Antimosan should be injected subcutaneously in the above manner, the dose being 40 c.c.

Tartar emetic is an irritant and can only be given intravenously, and care must be taken to ensure that it all goes directly into the vein, as even a few c.c. under the skin may cause serious inflammation and sloughing away of the tissues. Before attempting to give an intravenous injection, especially of an irritant solution, every farmer should, if at all possible, have the method demonstrated by a competent operator.

For such an injection one requires proper equipment; this consists of a syringe of suitable capacity, *i.e.*, 25 c.c. or more, a hypodermic needle about 2-2½ inches long and having a bore of about 1½ mm. and a 2-3 inch length of rubber tubing with the bore of small enough diameter to fit closely over the butt end of the needle, and over an adapter to fit the nozzle-end of the syringe. If a special adapter for this purpose is not obtainable the butt-end of a hypodermic needle which fits the syringe can be used, *i.e.*, an ordinary syringe needle can be cut off as illustrated leaving only the butt-end intact, to attach the rubber connection to the syringe. A 5 feet piece of thin soft rope (*e.g.*, sashcord) or flexible thin reim, with a loop at one end is required to serve as a tourniquet round the neck—by exerting pressure on this the vein is compressed and becomes distended with blood and easily palpable and visible.

The vein usually selected in cattle for the administration of intravenous injections is the jugular vein. This is a large vein situated in a furrow between the muscles at the side of the neck and a few inches above its lower margin. In this position it lies just under the skin and above the wind-pipe. The best site for puncturing it is about half way along the length of the neck. A right-handed person finds the right jugular vein easiest to work with, a left-handed person preferring the left vein.

The injection can be given with the animal in the standing or cast position. If standing it should be properly secured and the head should be held extended and turned slightly away from the side on which the injection is to be given. If cast, bringing up the vein without loose folds of skin is facilitated if a block of wood is placed crossways under the neck near the shoulders. Having got the animal in the desired position, place the thin rope round the neck near its base, the looped end being uppermost on the side of the operation, and the other end coming round the neck from underneath. Put the free end through the loop and pull the rope tight, at the same time pulling the dewlap away from the side to be injected so as to get the skin taut over the vein. Within a minute or so of applying pressure the jugular vein will become distended and readily palpable and visible. If there is any doubt, relax the pressure on the rope, whereupon the vein will again collapse, and when pressure is re-applied it can be seen filling. Always be sure that you get the vein properly distended before attempting to puncture it.

Having located the distended vein to your satisfaction swab the surface where you intend to puncture it, *i.e.*, about the middle of the length of the neck, with Lund's oil. This acts as a disinfectant and also a lubricant which facilitates inserting the needle. Have the syringe ready charged with the correct dose of solution, *i.e.*, 25 c.c. Grasp the needle, with its rubber tubing attached, firmly in one hand and with the other hand feel the distended vein to make sure of its exact location. Insert the needle obliquely towards the body through the skin and into the vein, keeping the cut or sloping face of the needle-point facing outwards. The needle should be pushed well into the vein to ensure that the whole of the sloping face of its point is completely within the lumen of the vein.

A few seconds after the needle enters the vein, blood will commence to flow from the rubber tubing. While this flow still continues attach the syringe, taking care that air bubbles have been excluded, *i.e.*, see that the space between the syringe plunger and the nozzle is completely occupied by the tartar emetic solution. Having attached the syringe, order the person controlling the pressure-cord (tourniquet)

to slacken this gradually and then slowly inject the solution. If, while the injection is being made, the animal struggles and there is any reason to suspect that the needle may have come out of the vein, immediately stop injecting, detach the syringe and do not commence to inject until free flow of blood through the needle has again been established—an increase in the pressure which has to be exerted on the syringe during an intravenous injection is a sure sign that the needle is no longer properly in the vein. When the full dose has been injected the needle may be quickly pulled out from the vein and skin, but it is a good policy to have pressure again applied to the neck rope and to draw up into the syringe a few c.c. of blood and then to squirt this back again into the vein. This ensures that any trace of solution is washed out of the syringe by blood and will not be left under the skin when withdrawing the needle. Always see that the pressure on the vein has been relaxed before withdrawing the needle, otherwise bleeding through the puncture wound may continue.

As soon as the injection has been completed, loosen the animal and leave it quiet. If the beast has been cast and does not rise immediately it has been freed, do not try to force it to rise, just leave it alone to get up when it feels like it.

Neither with antimosan nor with tartar emetic does a single injection suffice to bring about recovery, and although various systems of " timing " are recommended in different countries, experience in Southern Rhodesia has shown that three injections at intervals of a fortnight followed thereafter by one or more injections at intervals of a month have given good results.

In an area where re-infection is likely to be a constant danger one should not aim at effecting "complete cure," *i.e.*, sterilising the animal body of all trypanosomes, as in such a case the animal becomes fully susceptible again. The object is to establish such a balance between the animal and the trypanosomes that although the latter still remain in its system they do not produce any harmful effects but actually establish a state of resistance against further infection, *i.e.*, they bring about a state of premunity.

Recovered or premune animals are quite fit for slaughter for human consumption.

In the case of equines, in which severe infection is usually due to *T. brucei*, a proprietary drug known as Naganol is recommended, and should be used strictly in accordance with the directions supplied with it. Briefly, the course consists of three injections intravenously at intervals of one week. Another drug that appears to have given satisfactory results is Surfen C.

In dogs *T. brucei* infection is best treated with Naganol and *T. congolense* infection with antimosan.

Hordes of gullies now remind us,
We should build our lands to stay;
And departing leave behind us,
Fields that have not washed away.
Then when our boys assume the mortgage
On the land that's had our toil,
They'll not have to ask the question,
"Here's the farm, but where's the soil?"

—Anonymous. With apologies to Longfellow.

Published in *Soil Erosion and Its Control*, by Q. A. Ayres.

Horsesickness Inoculation.

Horsesickness Inoculation.—Vaccine for the inoculation of horses and mules of any age against horsesickness will be issued from now onwards until the end of November at a cost of 6/- per dose, post free.

Immunity does not reach its height until some months after inoculation, and owners are therefore urged not to defer inoculation until the end of the season.

The vaccine must be used within seven (7) days of its despatch from the Laboratory, and will be issued direct to applicants, who will be required to do or arrange for the inoculation themselves.

Directions for use will be supplied with the vaccine.

Applications, in writing, and enclosing the cash remittance, should be made to:

The Director of Veterinary Research,
P.O. Box 657,
Salisbury.

Orders will be dealt with strictly in rotation and according to the supplies which may be available at the time.

Applications will neither be acknowledged nor considered unless they are accompanied by cash (6/- per dose) and received by the 20th November.

HORSESICKNESS VACCINE.

Price: 6/- per dose.

Closing date for applications: 20th November.

Inoculate now.

Use within one week of its issue.

Hand Made Contour Ridges and Piece Work.

BY D. AYLEN.

Many farmers who have already protected most of their lands have each year a small amount of contour-ridging to undertake, perhaps on new lands or lands so flat it was not previously considered erosion would occur.

In such cases it is hardly worth while to use a ditcher and accordingly the contour-ridges are made by hand. For this reason it is felt that an account of the experience gained in the Native Reserves where some 2,000 miles of contour-ridges are now being made by hand each year would be of value and interest to the farmer.

The first significant factor which became noticeable was that full sized contour-ridges have never broken while those whose construction has been skimped, even where the skimping is so slight as not to be obvious except by vigorous checking, are a constant source of trouble until rebuilt to the standard

European supervision amounts to a bare minimum and, in fact, after supervising the layout and pegging of a system it may be months before the Soil Conservation Officer again visits the site, meanwhile the ridge building gangs are left entirely in charge of native overseers. Checking of the size must therefore be as near fool proof as possible.

In the Reserves hand made ridges are everywhere made to one standard size and shape, *viz.*, the narrow based bank and channel type, and though this account refers only to this type, a similar method of checking could readily be adopted for other shapes, provided of course suitable alterations were made to the template which is used for checking the contour-ridges. The template consists of a frame made of 3 in. x 1 in.

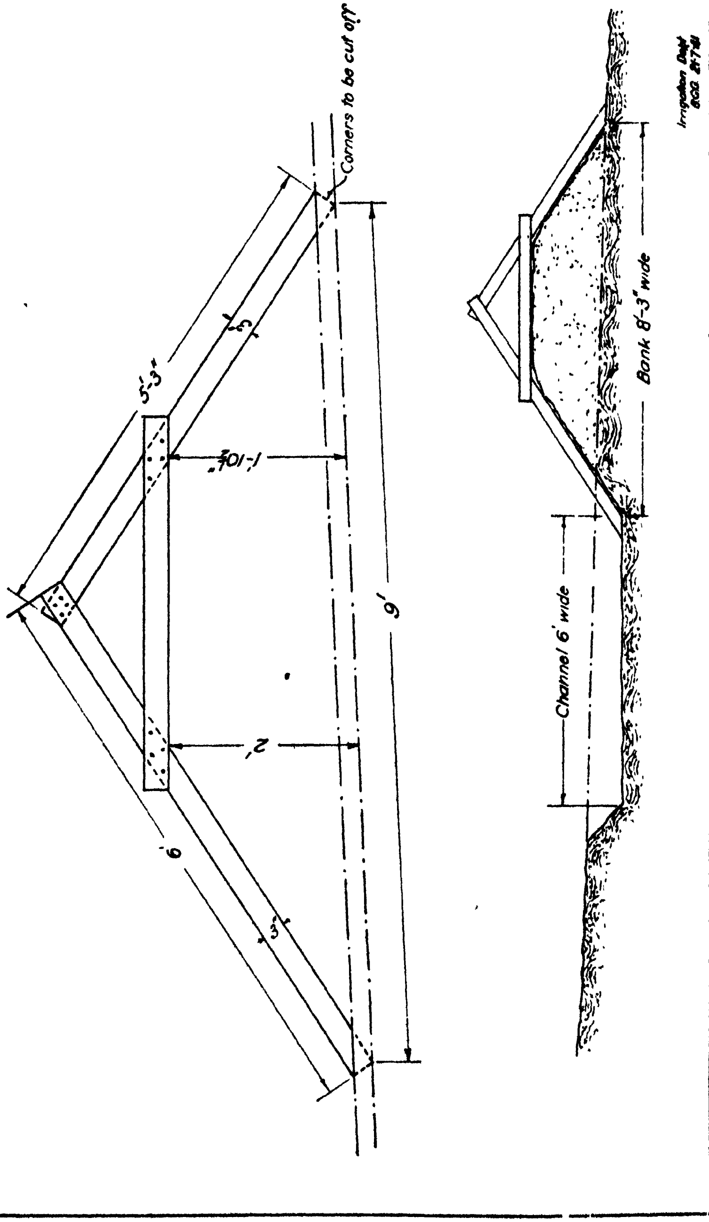


Fig. 1. Gauge for Contour Ridges.

plank shaped like a letter A, which is placed over the ridge bank. See fig. No. 1. A rod or plank six feet long is also provided for checking the channel.

The template only gives the correct size when all the soil for the bank is obtained from a shallow trench six feet wide on the upper side. It is obvious that with a deep narrow trench or if the soil is obtained from both sides, the position of one or both legs will be lower, resulting in a lower crest height. It will be noted that the longer leg is placed in the channel. The two measuring devices therefore must always be used in conjunction and never singly.

This shape and size of channel and bank is the very minimum which has been found to be reasonably safe for this type of contour-ridge for lengths not exceeding 250 yards. However, these narrow base banks are always subsequently gradually converted into the broad base type by the first few years ploughings. Later as the channel tends to silt up and after the bank has become widened to 12 or 14 feet the channel is opened by each ploughing. The system of ploughing which without any extra labour will achieve this result has been described in the article on "A New Ditcher" in the January, 1941, *Rhodesia Agricultural Journal* and previously in the "Soil and Water Conservation Bulletin," Part III. Briefly, a gathering furrow, or "acre," is ploughed round, or rather on the bank, and an opening furrow is ploughed in the channel and for a yard or so above and below it.

Whereas a broad bank and channel type ridge can be kept clean without danger of subsidence, a narrow bank is easily damaged by rodents, cattle, implements and natives, and is a source of weed, pest and disease infection. The narrow bank type of ridge must therefore be regarded as a temporary measure and the system of ploughing the land necessary for its conversion to the safer and better shape should be introduced at once. Even only two or three ploughings will, if carefully done, transform a narrow bank to a bank which at least can be kept clean without fear of its crumbling away.

To make the Template.--Mark out a nine foot length on the ground, or preferably against the foundations of a build-

ing, and using this as a base from a triangle with the 6 foot and the 5 feet 3 inches battens. Drive one nail through the joint and then place a 4 foot batten to form the bar of the letter "A." This batten should be 2 feet from the base line where it joins the longer leg and 1 foot 10½ inches from the base line at the shorter leg. All joints are now nailed firmly. (The template may be strengthened by placing another 4 foot batten on the other side.) The corners of the legs are now cut off, and when stood up the bar of the "A" should measure 1 foot 9 inches from the ground. The template thus gives a height from the bed of the channel to the crest of the ridge of 1 foot 9 inches.

Need for correct size of Ridge.—Contour-ridges made to this size should never exceed 250 yards in length. Reference to the "Soil and Water Conservation Bulletin," Part II., page 37, gives somewhat larger dimensions, *viz.*, for a narrow based ridge 350 yards long the height from channel to crest should be 2 feet 3 inches. This length should not be exceeded on tobacco soils. On loam soils ridges 500 yards long should have an 8 foot channel, a height of 2 feet and a bank width of 13 feet.

All farmers, whatever the method of construction, are strongly advised to check up the sizes of their contour-ridges, as unfortunately contour-ridges always appear far bigger than their actual dimensions. Fig. No. 2 shows a ridge made to the size and shape which is standard in the Reserves. It looks immense and yet on farms the contour-ridges should have greater capacity because of their greater length.

It is insufficiently realised that the peak discharge during an intense storm may amount for a short period to the astonishing rate of several hundred tons of water per hour. It is not improbable that an excessively long contour-ridge could be called on to discharge at the rate of nearly one thousand tons per hour for a few minutes during our most intensive storms.

Provided that ridges are made to the recommended sizes, that low places are made up and that cuttings through mounds are accurately graded and given sufficient width, contour-ridges will not break. Fig. No. 3 shows an absurdly narrow cutting through a low ant-heap.

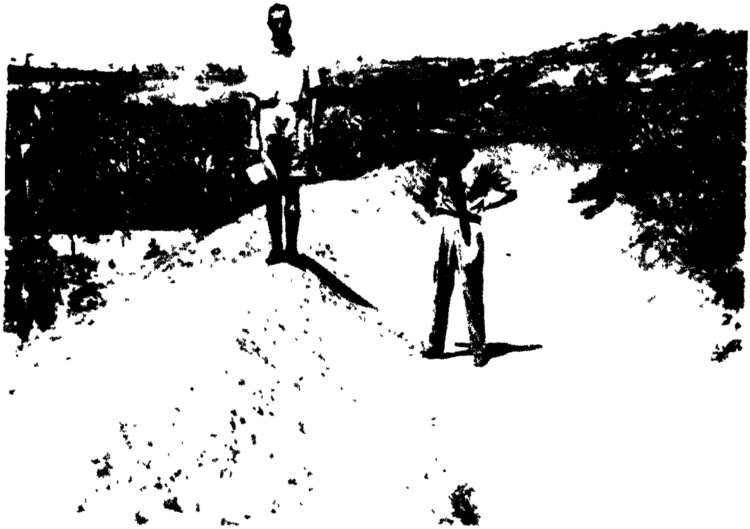


Fig 2 A contour ridge in the Reserves of standard dimensions

Fig 3 A narrow cutting through a mound. The commonest source of failure of contour ridges on farms.

One moved peg or one oversight may be all that is required to cause a whole system to collapse, each lower ridge giving way soon after the one above breaks under the irresistible force of tons of charging water from the original point of failure.

It therefore pays to check up ridges by some method or other which gives the correct size. Boning rods should then be used to check the bank where the ridge crosses depressions and the channel where it crosses gravel, mounds or ant-heaps. Boning rods and several methods for checking the size were described in "Soil and Water Conservation Bulletin," Part II.

It is a matter for serious regret that few farmers realise what a full-sized contour-ridge looks like. They would be surprised if they took the trouble actually to measure the size of their contour-ridges. It is not so much due to "wishful thinking" but as stated before to the fact that a contour-ridge looks far bigger than it really is. I hate to record it, but the standard of construction on farms generally compares very unfavourably with that in the Reserves, because most farmers seem to have an aversion to checking up their ridges.

In the Reserves the system described here has been adopted because (*a*) it is almost foolproof; (*b*) it ensures an adequate sized contour-ridge; (*c*) it gets more work out of the native. It therefore could be adopted on farms to considerable advantage in order to ensure cheaper and better work with lessened supervision.

Piece Work Prices.—There are numerous infrequently visited gangs scattered over the Reserves. Each gang is in charge of a native who with the rod and the template checks the ridges and also measures up the length done by each native of the gang.

On well ploughed soil, loose and free from clods, a native was given a daily task of about 20 yards, and where poorly ploughed or cloddy, about 15 yards, but it was soon found more satisfactory to pay by the yard, as then a really good native on good soil conditions would do up to 48 yards a day.

The actual average throughout the year is about 30 yards per boy day. This figure is made possible because, except under unavoidable circumstances, the strip is well ploughed.

The rates are as follows:—

Well ploughed soft loose soil	4 yards a penny.
Ploughed but cloddy soil	3 yards a penny.
Moist sand not ploughed	3 yards a penny.
Unploughed but not too hard soil	5 yards for twopence.

Thus though the better native now earns more money, he does the work at a lesser cost per yard.

Quite a number of farmers have given me lower costs than these for the construction of hand made ridges, but I would ask them to place a template over their ridges and reconsider their figures.

A further feature insisted on in the Reserves and often overlooked on farms is that the soil should not be piled in a loose heap; instead the bank should be built by stages in layers of about four inches thick, each layer being tramped or pounded before another is put on top, rather like building an earth dam, otherwise the loose soil will settle 3 or 4 inches during the first season. Even an apparently packed bank of cloddy soil has been found by measurement to have sunk 3 inches during the first season.

If it is decided to introduce the yardage system of payment the natives should be started on task work for a few days until they become used to the work.

Do not let them elect to attempt a greater length than they can do comfortably otherwise they will take a day off every few days in order to rest.

It is a good investment to provide good shovels, and if picks or mattocks are required see they are sharp, though it is not truly economical to work in conditions where any other tool than a shovel is required.

The whole secret of economical construction, whether by ditcher, scraper or shovel, is good ploughing.

I might add a warning here to farmers who contemplate using a ditcher behind a wheeled tractor. The construction must be done before ploughing the land. Only the narrow

strip should be ploughed otherwise wheel slippage will be so great the tractor won't be able to pull. It will also be found that ditcher work is one of the few cases where iron wheels and spuds have an advantage over rubber tyres.

Further Notes on Piece Work.—Owing to the general labour shortage I have been thinking in terms of the farmer who only has a very limited yearly programme of soil conservation; but there still are a few lucky farmers who have sufficient natives available for a fairly considerable scale of contour-ridging. In such cases a farmer might give each native a separate ridge and measure up the yardage weekly.

An interesting system of graded piece work has been adopted on at least one farm with considerable success. The farm gang is sub-divided into groups with separate rates of pay, *e.g.*, the natives in the 17s. 6d. gang must do 50 per cent. more work than those in the 12s. 6d. gang. This farmer thus gets 50 per cent. more work for the same rations and 40 per cent. higher wages from his better paid boys than those on the lower scale.

Any native may elect to move up or down the scale on a new ticket, but naturally the lower paid gangs are kept as small as possible. Actually the tasks in the lower paid gang are about the average, but the wages a little below that for full grown natives. This gang consists almost entirely of newcomers and picannins.

This pay is somewhat balanced by a small graded weekly "bonsella" on Saturday afternoons, when boys who have not skimped or neglected their work during the week are given a small reward. The small amount of extra book-keeping involved is more than balanced by the fact that this farmer had no need to stand over his gang once the system began to run smoothly. Sheepdog tactics, tiring for the farmer and heartily disliked by the native, are for him a thing of the past. What is more, not only is he a popular employer, but he gets more work out of the native, and it is better done too.

Piece Work Tickets.—It might be worth while trying an adaption of the system of tickets used in the Reserves. There the daily spaces are subdivided and instead of the date the amount of work done and its value are entered. The ticket

runs for one calendar month and on days the native does not work the space is cancelled. The marking of actual money on a ticket is a strong inducement to the native to work harder.

At the side of the ticket is a column for weekly totals of work and pay and at the foot a space for the monthly totals. The grand total of all tickets is checked against the work done by the gang.

In conclusion, I would like to say that the suggestions given in this article have all stood the test of two years or more. If any farmer contemplates their adoption there will naturally have to be a transition period with attendant increased work for him, but where the piece work system is gradually introduced on some task work which can be easily checked and measured his difficulties should be reduced to a minimum.

One is chary of offering advice on any innovation at a time when both labour and supervision are suffering from a shortage, but this article has been written because I sincerely believe it offers a practical solution which will tend to ease the position.

AT LAST.

The shoemaker must stick to his last, but the farmer must stick to agricultural cleanliness first *and* last.

CLEANLINESS AIDS

VICTORY

Diseases of Fruit, Flowers and Vegetables in Southern Rhodesia.

3.—COMMON DISEASES OF SNAPDRAGONS.

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A.,
Senior Plant Pathologist.

DAMPING-OFF.

Description.—True damping-off is a disease confined to seedlings, many plants other than snapdragons being susceptible. The trouble is well known among gardeners, some of whom have much difficulty in controlling it. Young plants from the stage of emergence up to the time of pricking out may suddenly collapse and die in patches (plate 1, fig. 2), the disease rapidly spreading through the seed boxes or seed beds, often causing complete destruction.

Cause and Contributory Conditions.—Damping-off is caused by soil-inhabiting fungi, which invade the delicate stems of seedlings, producing a rot at soil level and causing the tops to collapse. The fungi then grow rapidly over the dying plant until it is reduced to pulp. The following have been found to cause damping-off of Antirrhinums in Southern Rhodesia: *Pythium debaryanum*, *Rhizoctonia solani* and *Phytophthora parasitica*.

As its name implies, the disease occurs when seedlings are grown in soil of high moisture content, especially if accompanied by inadequate ventilation and light. It is very prevalent during the warm rainy months of December, January and February, and is particularly troublesome where seedlings are raised under thatch to protect them from beating rain. Many gardeners make thatch covers which they place a few inches above the tins, thus reducing light to a minimum and interfering with ventilation.

Control.—Control of the disease consists of remedying faults in cultivation and using fungicides. Seedlings should never be raised under low shade. They require a certain amount of sunlight but not enough to heat the soil excessively. High shade, such as is provided by a tall tree, is excellent, but if thatch is used to protect the seedlings from heavy rain, then it should be raised several feet above the tins. In addition, it is a wise plan to treat the soil with some chemical which will either inhibit the growth of the damping-off fungi, or else to sterilise the soil by soaking the filled tins in boiling water for 20 minutes. The simplest method, which has been found to be highly successful, is to dust lightly the surface of the soil with Bordeaux powder from a muslin bag after the seed has been sown and covered up.

FOOT ROT.

Description.—Foot rot can be regarded as an exaggerated form of damping-off and, in fact, may be caused by some of the damping-off fungi. The first signs of the disease are wilting of the tops of the plants which soon spreads to the leaves of side branches. In the end the plant dries up and dies. (Plate 2, fig. 4.) If the plant is pulled up when the symptoms first appear, it will be found that the stem at soil level shows a discoloured patch which is soft and comes away easily if squeezed between the thumb and forefinger. As the disease advances, the rot encircles the base of the stem and the tissues shrink in this region. The disease should not be confused with that caused by nematode attack upon the roots. In the case of foot rot, the nodular swellings which are typical of nematode infestation are absent. The progress of the disease may be quite slow. Plants sometimes become infected soon after setting out in the beds, but continue to grow for several months without showing any pronounced symptoms. They then suddenly wilt and collapse within a day or two.

Cause and Contributory Conditions.—The most frequent cause of foot rot in Southern Rhodesia is infection by the fungus *Phytophthora parasitica*, which is almost invariably followed by *Rhizoctonia solani*. Infection most commonly takes place at the time of transplanting if plants are allowed to wilt before they become fully established, and it is not unusual for the young transplants to be killed at this stage.

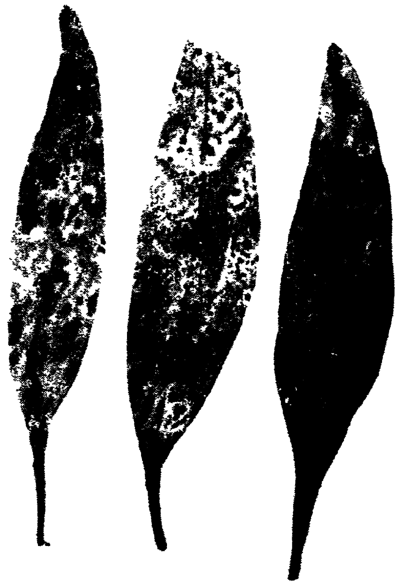


Plate 1 Fig. 1. Rust pustules on undersides of leaves.

Plate 1 Fig 2 Damping-off of snapdragon seedlings

Plate 1 Fig 3.—False rosette caused direct aphid damage Recovery of plant after removal of aphids

Plate 2 Fig 4.—Foot rot of snapdragon on year old plant

The disease may also develop on snapdragons which are more than a year old, and it is inadvisable to grow these flowers for more than one year. High soil moisture content is favourable to the development of foot rot and the same casual fungus has been shown ([1]) to produce a similar disease in tobacco growing in waterlogged soil.

Control.—The disease may be prevented by adjusting soil conditions to avoid excessive humidity. Beds should receive a good dressing of compost, should be well drained and cultivated at regular intervals. At time of transplanting, it is a good plan to provide the young plants with light shade, and many gardeners place a mulberry leaf, with its stalk inserted in the soil, over each transplant. The leaf gradually dries up, so that, by the time the plant is established and is beginning to grow, the leaf falls away. In addition, it has been found that a level teaspoonful of Bordeaux powder sprinkled round each plant at the time of setting out almost entirely prevents the development of foot rot. Alternatively, the disease may be prevented by watering the beds three times at weekly intervals with Cheshunt Compound made up as follows:—

Finely crush 2 ozs. copper sulphate (bluestone) and 11 ozs. ammonium carbonate, especially the latter, and mix intimately. Place the mixture in a glass or earthenware screw top jar and allow to stand for at least 24 hours when the mixture will take on a vivid blue colour.

Dissolve 2 ozs. in a little hot water and make up to 2 gallons with cold water for the first application. The solution may be used at double this strength afterwards.

RUST.

Description.—Snapdragon rust has only recently appeared in Southern Rhodesia but already seems to be widespread. It was first reported from Bulawayo district in October, 1940, where it was already well established. During the last two months a number of reports of the disease have been received from Mashonaland. The means by which it was introduced to the Colony have not been ascertained but, although rust is reported in scientific literature as not being seed-borne, it

is suspected that it may have reached this part of Africa in seed from overseas. Microscopic examination of many samples of seed have shown that all contain a relatively high proportion of rust spores, but experiments conducted with this seed have produced only healthy plants.

Snapdragon rust is extremely serious and is capable of destroying whole plantings in a short while. The disease first appears as small, circular, yellow dots on the leaves, usually when the first flower buds are formed. The spots may be few or numerous. When few they are not easily detected, but when numerous they are quite noticeable and cannot well be overlooked. If the undersides of the leaves are examined at this stage, small raised lumps resembling pimples will be seen corresponding with each yellow spot. A little later the skin covering the swellings ruptures to expose rusty-red, powdery pustules, which may be isolated or grouped together and sometimes form circular patterns (plate 1, fig. 1). The disease progresses rapidly, causing the leaves to shrivel and not infrequently killing the plants outright.

Cause and Contributory Conditions.—Snapdragon rust is caused by the fungus *Puccinia antirrhini* and the powdery dust in the pustules on the undersides of the leaves is composed of thousands of spores, by means of which the disease is spread from plant to plant and from garden to garden. These minute spores can be transported great distances by currents of air starting up an outbreak of rust wherever they alight under suitable conditions on an antirrhinum plant. The disease is of such recent occurrence in Rhodesia that local conditions favouring its development have not been ascertained with certainty. It does, however, appear that rust is likely to be a more serious menace during the cool winter months than in the summer. All young diseased plants which have been inspected during the last two months have shown a very high degree of infection, whereas older plantings, which made their main growth during the summer, were less seriously affected; about 50% only of the plants being badly diseased. These observations agree with reports from Europe, which state that 50° F. is the optimum temperature for spore germination, which is inhibited by temperatures over 72° F.([2]), ([8]). It would appear that low atmospheric humidity in Rhodesia

has little or no effect in retarding the disease. One of the principal contributory conditions for the rapid spread of rust is the presence in gardens of old infected plants. Very heavy infection of seedlings in tins has been observed when diseased volunteers were growing in close proximity.

Control.—The most important control measure is undoubtedly the removal of all infected plants and their complete destruction by burning before new sowings are made. Unless this is carried out thoroughly there is little chance of growing snapdragons successfully on a commercial scale. Furthermore, these flowers should not be grown successively in the same piece of soil, as it is known that rust can tide over in this medium for some considerable time. The most satisfactory form of control is the planting of resistant varieties, and so-called "resistant" strains of seed are sold, but, generally speaking, these varieties do not breed true to resistance and have not attractively coloured flowers. Some American seed firms have ceased to catalogue "rust restraint" varieties owing to the present unsatisfactory position. Efforts, therefore, should be made to prevent infection taking place, and fortunately, there are a number of effective fungicides which will accomplish this. Many recommendations have been made in different parts of the world and opinion is divided as to whether sulphur or copper sprays are the most efficacious. The most easily obtained fungicide in Southern Rhodesia in small quantities suitable for use by gardeners is Bordeaux Mixture. This should be used at a strength of 8 lbs. of ready-mixed powder to 40 gallons of water, to which should be added 1 oz. of Lethalate or 5 ozs. of casein spreader. "Bouisol" may be used at a strength of 1 pint to 10 gallons of water plus 4 ozs. of good household soap as spreader. Dusting sulphur is also said to give good control, particularly when temperatures are high, and colloidal sulphur at the rate of 8 fluid ozs. to 10 gallons of water plus 4 ozs. of household soap as spreader is also said to be effective. Spraying should commence when the plants are about 2 inches high and two further sprayings should be given before the flowers are open. Seed treatment does not appear to be called for in view of the reported inability of the disease to be transmitted in the seed.

LEAF SPOT.

Description.—Only one kind of leaf spot is reported to be troublesome in Southern Rhodesia. This first appears as small pale spots, which enlarge to form small, ashy-white areas surrounded by a thin reddish-brown margin. Sometimes these spots develop into irregular pale blotches, causing the leaf to become distorted or, very occasionally, to be shed. At other times the spots remain small and the centres fall out to give a "shot-hole" effect. If examined with the aid of a magnifying glass, a few raised black bodies, which contain the spores of the fungus, may be seen in the centres of the spots or embedded in the ragged margins from which the tissue has fallen away.

Cause and Contributory Conditions.—The disease is caused by the fungus *Phyllosticta antirrhini* and appears to be favoured by moist conditions. It is, as a rule, more prevalent in the rainy season but seems to be favoured by overhead watering in the dry season.

Control.—Leaf spot should not be troublesome if hygienic methods of cultivation are employed and diseased refuse is destroyed before new sowings are made. Snapdragons should not be planted successively in the same beds and young plants should not be grown adjacent to older plants which are affected by the disease. Overhead watering should be reduced as much as possible. Young plants may be sprayed with Bordeaux Mixture plus spreader, once before transplanting and twice afterwards as an additional precaution. Spraying, however, is not usually found to be necessary in this Colony, but may be essential now that rust has made its appearance.

"ROSETTE."

It is not uncommon to see young snapdragons exhibiting severe distortion of the growing points of the main stem and side branches. This condition is accompanied by stunted growth and the production of multiple side branches. The symptoms are strongly suggestive of the rosette disease of tobacco and, as aphids (green flies) are invariably present, the idea has gained ground that the snapdragon disease is caused by the tobacco rosette virus.

Tests carried out at the Plant Pathology laboratory have shown this contention to be erroneous. No disease symptoms appeared when aphids from affected snapdragons were fed upon healthy tobacco plants and the Antirrhinums made normal growth when the aphids were killed by a nicotine spray. (Plate 1, fig. 3.) The distorted growth was evidently the direct effect of insect injury. Similar instances have occurred in Clarkia, Godetia and cornflower.

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([1])Hopkins, J. C. F. (1930).—*Proc. Rhod. Sci. Ass.* xxx., p. 49.

([2])Kochman, J. (1938)—*C.R. Soc. Sci. Varsoire* xxxi., 4.

([3])Pape, H. (1936)—Krankheiten und Schädlinge der Zierpflanzen, Berlin, p. 134.

DO YOU KNOW WEEVIL?

Are you one of those who—
See no weevil?
Hear no weevil?
Speak no weevil?

Cleanliness Aids Insect Control.

The Raising and Planting of Trees on the Farm.

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Conservator of Forests.

In the following article, which is a revision of Bulletin No. 1087, the procedure advocated refers mainly to the commoner trees planted in this Colony, *viz.*, eucalypts, pines, cypresses, callitris, cedrela and jacaranda.

It may not be out of place to explain some of the terms used. A "seedling" is a young tree resulting from the sowing of seed and it may be any height. A "transplant" is a seedling that has been removed by transplanting from its original site in the seed-bed to tins, trays or nursery beds for a further period of development before final planting out.

RAISING PLANTS.

Source of Seed.—Seed may be purchased from Government Forest Nurseries as quoted in Departmental price lists, or from nurserymen of standing. If, however, trees of the species it is desired to establish are thriving in the locality, it may be cheaper to collect seed from them. Only well formed mother trees should be selected, and, *ceteris paribus*, trees bearing excessively heavy crops of seed should be avoided, as their condition might indicate ill-health or non-suitability to the locality.

Branchlets carrying ripe seed vessels or cones should be picked and piled on a sheet of convas or some large open vessel, and placed in the sun in a spot protected from wind. In the course of two days to a fortnight the vessels will open and free the seed. Shaking and turning over the pile will accelerate liberation. The seed is finally collected from the threshing floor, and, if not to be sown immediately, should be stored in a cool, dry place. It is obvious that single seeded fruits will not need this treatment.

Quantity of Seed for Planting Requirements.—It is wise to sow sufficient seed to produce more plants than the ultimate number per acre required for planting. To ascertain the approximate number of plants required per acre for any planting distance, in the more usual square-planting, the rule is to divide the number 43,560 by the square of the planting distance, thus:—

Planting distance = 6 feet by 6 feet

$$\text{Number of plants required} = \frac{43{,}560}{6 \times 6} = \frac{43{,}560}{36}$$

$$= 1{,}210 \text{ plants}$$

In order to produce at least 1,210 plants, the following quantity of seed should be sown:—

Eucalyptus saligna, *E. botryoides*, *E. rostrata*, *E. tereticornis*, *E. punctata*, *E. maideni*, *E. microcorys*	1 oz.
Pinus radiata, *Cupressus torulosa*, *Cupressus lusitanica*, *Cupressus arizonica*, *Callitris calcarata*, *C. robusta*, *Cedrela toona*	3 ozs.
Pinus longifolia	4-5 ozs.

Time of Sowing.—Eucalypt seed may be sown during August to mid-November for planting out during the same rainy season.

If the plants are to be pricked out into tins the seed may be sown in August-September, but if the intention is to plant direct from seed-beds the seed should not be sown before October, as the plants grow very rapidly and very often become too large to transplant easily.

Cedrela toona should be sown fresh immediately after ripening in December for planting out during the same rainy season.

Seed of pines, cypresses and callitris may be sown during February, March and April for planting out in the following rainy season.

Preparation of Seed-beds.—The nursery should be in a locality near permanent water, protected from winds and carrying a well drained soil. Due regard should be paid to the distance of the planting area and, to facilitate supervision, the homestead.

The soil should be well broken up and reduced to a fine tilth. No sticks, stones or clods should be left in the upper 3 inches of soil. Sterilising by burning and fertilising are not ordinarily necessary. A light sandy loam is suitable for a temporary nursery. For a permanent nursery a mixture of heavier soil and leaf mould may be added to the end that the soil will be both friable and retentive of moisture.

When the soil has been well tilled, beds 3 ft. 6 ins. in width, of any suitable length, and about 20 ins. apart, should be marked off, levelled and pressed down to ensure a smooth surface. Plate 1 shows a suitable implement to smooth the surface of the beds. It consists of a board nailed to a handle.

As an alternative to the use of seed-beds, half petrol tins, filled with soil as already indicated, may be utilised. They have the advantage of being easily transportable to the pricking-out site, and, when uneven germination is experienced, they enable the grower to work systematically with the seedlings as they reach the pricking-out stage. Direct planting is not ordinarily advisable from seed tins.

Sowing the Seed.—Seed may be sown broadcast, the density of sowing being dependent on the desired subsequent treatment. If it is intended to prick out seedlings into tins or trays, 3 to 4 ozs. of eucalypt seed and 6 to 8 ozs. of conifer seed may be sown to the square yard. The easiest way to gauge the density of sowing is to aim at a condition where slightly more seed is visible on the seed-bed than soil.

If the seedlings are to be planted out direct from the seed-beds a much lighter sowing—about 1 oz. to every 10 to 20 sq. yds.—should be carried out, depending on the size of the seed.

For planting out direct, line sowing may also be adopted. Seed is sprinkled along the surface of the bed, or dibbled-in, in the case of large seeds, in lines about 6 ins. apart. This

system naturally requires more space than broadcast sowing, but it has the advantage that thinning, weeding and root pruning operations are facilitated.

Broadcast sowing by hand gives good results in most instances. With very fine seed it may be sometimes advisable to mix the seed with fine sand to ensure even distribution. The sowing of eucalypt seed through a watering can is neither necessary nor advisable. When the seed has been sown it should be covered with a layer—the depth equal to the breadth of the seed—of sand or other soil which has previously been put through a sieve of fine mesh. The beds, or seed tins, should now be covered with well combed grass of sufficient thickness so that the soil cannot be seen. See Plate 2. As the grass may come in direct contact with the seed it is important to have it well cleaned, otherwise "white ants" may be attracted to the beds. A good watering should now be given to the seeds through the grass. Tobacco muslin may be used instead of grass, but, especially with eucalypts, it renders the operation of gradually lessening the shade more difficult.

Care of Seed-beds.- Watering of the beds should be carried out once or twice daily. The weather conditions prevalent over the germination period will indicate the frequency of watering desirable. Success lies in keeping the soil moist, though not sodden. Germination should take place within six to fourteen days in the case of eucalypts and cedrela and fourteen to thirty days or more for pines, cypresses and other conifers.

When germination is complete most of the grass should be removed, a very light covering being left for a few days to enable the young seedlings to harden off. All the grass should then be removed. If the grass is left on too long the seedlings will tend to spindle and will be useless for pricking out. This operation of removing the shade gradually is very important, especially with eucalypts, which are extremely tender in early youth.

In the case of beds sown for plants to be planted out direct in the field, the seedlings should be thinned out where they are too dense, leaving about 80 seedlings to the square foot. Thinning should be done by cutting out undesirable plants. Pulling is bad practice, as it damages the roots of the plants

which are to remain. Weeding should be carried out whenever necessary, and waterings must also be frequent.

With eucalypts, when the young plants have from six to ten leaves, root pruning should be resorted to at intervals of about three weeks to encourage the formation of a fibrous root system. The operation is carried out by inserting a long-bladed knife or sharp spade 4 to 5 inches below the surface. With other species root pruning should start when the plants are 1½ to 2 inches high. Line sowings are more easily treated by this operation. See Plate 3.

Inoculating Soils for Pine Seedlings.—It is necessary at this stage to draw attention to a soil requirement which appears to be essential to healthy pine growth in various parts of the Colony. This requirement is a fungus which, acting in association with the roots of pines, enables them to carry out their normal function. Without this fungus assistance young pines tend to remain stunted and to bear an unthrifty, sickly yellow appearance. Soils carrying thriving pine plantations are well infected with the fungus. When soil from such plantations is introduced to new nurseries, healthy pine seedlings result. This procedure is now advocated wherever pines are to be raised. It is well to inoculate the soil both in the seed-beds and transplant tins. A handful to the square foot would suffice, and should be forked or raked into the new soil.

Pricking Out.—The primary object of all pricking out is to ensure that each plant shall have a well-developed root system. Where seedlings are pricked out into tins or trays, the resulting transplants are finally planted out with a ball of earth surrounding each root system. In inexperienced hands and in a climate where droughts are frequent, balled plants are liable to less risks in planting out and are more capable of readily establishing themselves than open-rooted plants, which are used when seedlings have been pricked out into beds. The latter method is obviously cheaper, although it is in turn more expensive than the use of plants set out direct from seed-beds.

Pricking Out into Tins or Trays.—Petrol tins cut longitudinally in half or wooden boxes approximating to them in size are most commonly used for the reception of pricked out plants. A few holes to facilitate drainage are punched in the bottom of the tins, which are then filled almost to the top with, preferably, previously prepared soil. Such prepared soil might consist of three parts heavy loam, three parts sand and one part well rotted vegetable matter. This should be well mixed, sieved if necessary, watered and thrown into a heap until required. The object is to obtain a soil which will bind slightly and not give off moisture too rapidly.

The soil in the tins is then watered, and holes, equidistant and 25 to 30 per tin, are made either with a pointed stick alone or with the assistance of a dibbling board, of a size to fit the tin, with holes about half an inch in diameter spaced as required. A dibbling stick is inserted through these holes into the soil. The tins are now ready for the pricked out seedlings.

In cases where tins or wooden trays are unobtainable and it is essential that plants be pricked out into containers, earthen pots as described by Major Wake in "The Pot Planting of Eucalypts," Bulletin No. 1087, may be used. Containers may also be made of half cylinders of bark closed at either end, somewhat on the lines of the common native bee hive.

The operation of pricking out is best carried out in the shade. It is well previously to construct a simple shade house made of poles, with a loose roof of branches carrying sufficient foliage to allow plenty of light within the structure, at the same time appreciably lessening the intensity of the sun's rays. A portion of the shed should be fitted up with a rough table and have complete shade overhead. The tins containing the soil are placed on the table ready for the seedlings. Seedlings are ready for pricking out when they are about 1½ inches high, and in the case of eucalypts, when they have two to three pairs of leaves. With a spade a clod of earth carrying sufficient seedlings to fill two or three tins is dug out and carried quickly to the table in the pricking out shed. Great care should be taken to expose the roots as little as possible to the air. With a pointed dibbling stick

the seedlings are removed from the clod of earth one by one and quickly examined. If the tap root is too long and obviously out of proportion to the rest of the plant, it should be nipped off with the thumb and forefinger, leaving a root which is half as long again as the stem. If the tap root is badly bent, or the seedling otherwise ill-shaped or unhealthy, the plant should be thrown away. The plant, having been examined and found suitable, is inserted into the prepared hole, and the soil is pressed against it from the side with the dibbling stick in such a manner that the root is not bent and that there is no air pocket at the base of the hole. The seedling should be inserted no deeper than it stood in the nursery bed, *i.e.*, at the collar. A seedling pricked out with a bent tap root, or with the collar deep in the soil, starts with a handicap from which it will never recover. It simply means waste of money, labour, time and a gap in the plantation.

As each tin is filled with plants it is placed in the partial shade of the other part of the shed and watered through a fine rose. Subsequent waterings need only be given when the soil shows signs of drying out. After a week or ten days in the partial shade the tins are placed out in the open sunlight, where the plants are allowed to harden off.

Pricking out into Beds.—If it is desired to use open-rooted plants, pricking out into transplant beds will ensure better individual root systems than are obtainable with seedlings set out direct from seed-beds. The same treatment and method of preparing the beds are followed as already described. Holes are prepared in the beds with a dibbling stick through a dibbling board in which holes have been bored with an espacement of, say, 2 inches by 3 inches. Tins or clods of earth containing seedlings are carried to the beds, where pricking out is done as before. Temporary and partial shade may be erected over the beds, and may be maintained during the hardening-off process.

Care of Plants Prior to Planting Out.—Plants which have been pricked out into tins or beds, or which have been left in the nursery beds for direct planting, should be watered frequently; dead plants should be replaced and weeding carried out. If planting rains are long delayed and the young plants show a tendency to too rapid growth, this growth

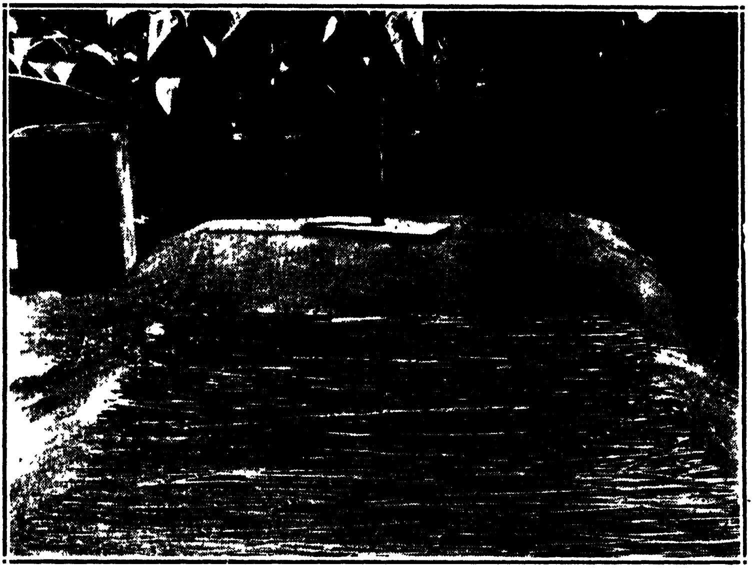


Plate No. 1 Method of making seed beds Note the board for levelling and grass cover Well combed grass should be used

Plate No. 2 —Method of raising trees in lines in the beds (cutting the tap roots).

should be checked by watering very sparingly. The plants should in effect be made to struggle. The leaves, if the plants are given sufficiently short rations of water, will take on a bluish or brownish colour. This need cause no alarm, as hardy plants will result. On the other hand, this will be the sign that a watering must be given soon in order to keep the young plants alive. If the planting of trees contained in tins is held over for any length of time, periodical inspections should be made by turning over the tins and pruning off all the roots which have come through the drainage holes.

METHOD OF RAISING CAROLINA POPLAR CUTTINGS.

Preparation of Cuttings.—Both end cuttings and cuttings with lateral buds are used; these are made during July or August and are made 7 inches long, the thickness varying from $\frac{1}{8}$ inch to $\frac{3}{4}$ inch. All cuts are made horizontally and not obliquely in order to reduce the area of the exposed surfaces. The upper end is cut as close as possible to the topmost lateral bud and all other buds are removed.

Setting the Cuttings.—The nursery is first of all dug over and raked level and the cuttings planted 8 inches apart, a space of 16 inches between the lines being allowed.

A short piece of $\frac{3}{4}$ inch piping is pushed into the soil for a depth of about 9 inches and about 1 inch of clean humus-free river sand is placed in the resulting cylindrical hole. The cutting is then placed so that more sand can be rammed in around and about 1 inch above the cutting, the idea being that the cutting throughout its whole surface is in contact with sterilised material and not in contact with rot inducing agencies.

PLANTING IN THE FIELD.

In the planting of young trees it is most important that great care be exercised. Careless planting can be accountable for a large percentage of losses in a plantation, and expenditure incurred in careful planting is money well spent.

Planting Distance.—It has been found generally in this Colony that a planting distance of 6 feet by 6 feet is the most economical and serviceable. This espacement ensures, under

normal conditions, the formation of a canopy at an early age in the life of the wood. It prevents the formation of heavily branched trees, the timber of which would not be of first quality, and it gives a reasonable margin in allowing for failures and still having a well-stocked stand of established trees. Some slow-growing trees, or trees which have a pyramidal habit of growth, may even be planted 5 feet by 5 feet. Good examples of these trees are *Callitris calcarata* and *C. robusta*, which, in the tree-veld zones, do not ordinarily form canopy until the fifth year from planting.

The following table gives the number of trees per acre for some of the more common espacements:—

Spacing in feet.	Number per acre.
5 x 5	1,742
6 x 6	1,210
7 x 7	889
8 x 8	681
10 x 10	436
12 x 12	302

Period of Planting.—In theory, planting may be carried out at any time of the year. In practice, however, the planting period in this Colony is confined to the rainy season. The hard experience of many disappointments has shown that in the tree-veld zones—*i.e.*, the regions west of the high eastern border—planting should be left over to the latter half of the rainy season, for two main reasons, *viz.*:—

(i.) The rains in October, November and December are often extremely unreliable, and are generally characterised by thunderstorms and short heavy downpours. Following on the long dry season, the soil is usually so baked that intense evaporation and run-off allow very little moisture to soak into the ground. In consequence, trees planted during favourable weather in these three months have only surface water upon which to draw. This encourages a surface root system. The intra-seasonal droughts, which are common, effect an almost complete drying out of the surface layers of soil, with the result that the young plants are caught high and dry, and

if they do not actually succumb, they are so weakened that they fall an easy prey to disease and that ubiquitous scavenger, the termite or "white ant."

As a contrast with this, the rains of January, February and March have a steadier and more persistent fall. The cloudy weather retards evaporation, and run-off is appreciably lessened, with the result that conditions favour the soaking of water into the soil and sub-soil. Young trees planted in such soil have therefore every inducement to develop a strong taproot. When the rains cease and the water table sinks, there is no longer mere inducement to the roots, but actual stern compulsion to follow the sinking water table if life is to be maintained.

(ii.) During the first half of the rainy season the growth of grass and various weeds is particularly vigorous, and unless this is kept in check, often at great expense, the competition with which young trees are called upon to contend is severe and exacting. By the end of January, however, the weed growth has relaxed considerably in vigour, with the result that more food and moisture become available to the recently set out plants.

A consideration of the foregoing will show that planting over the larger portions of the Colony should be confined to the latter part of January to February and March, and even in years of good rainfall, early April. Planting may nevertheless be carried out in December if steady soaking rains occur at that time.

Planting Weather.—Planting is most successfully carried out on dull, windless and drizzly days, and preferably in late afternoon. Sun and wind produce a less humid atmosphere, which necessitates the exercise of more than ordinary caution in limiting the exposure of the roots of plants to the shortest possible time.

Size and Shape of Plants.—In ordinary forest practice in this Colony, plants should be set out when they are 3 to 6 inches high. The root system should be well balanced in relation to the rest of the plant, and should be well supplied with small fibrous roots. Taproots of undue length should be nipped off to a reasonable length as well as abnormally

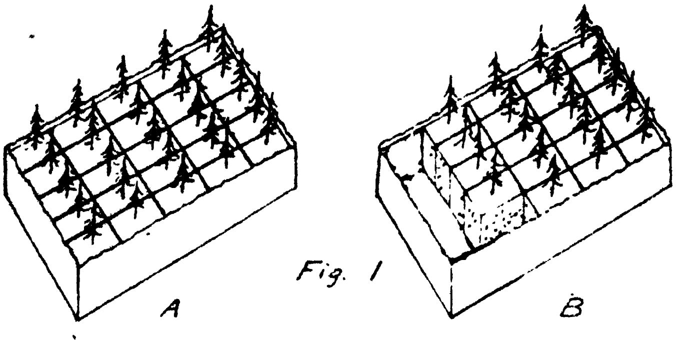


Fig. 1

Cutting cubes and removing from tins.

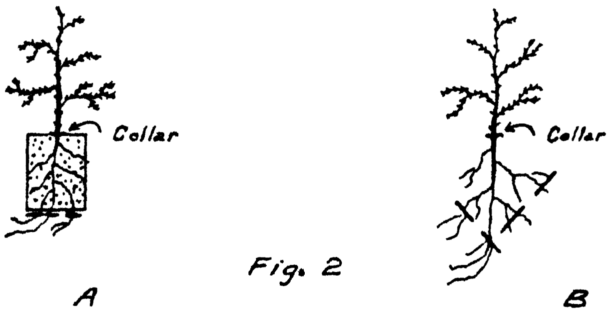


Fig. 2

Root-pruning plants: A: From tins B: From beds.

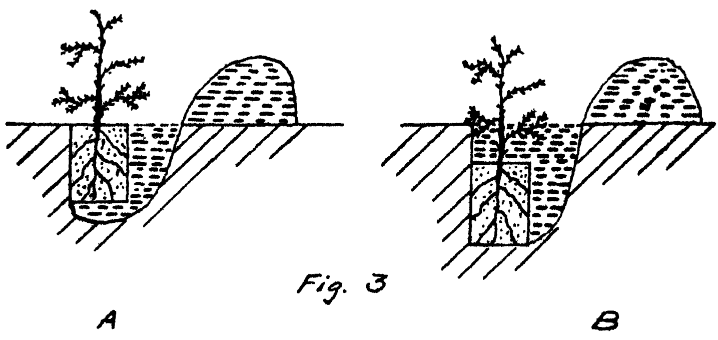


Fig. 3

Planting from tins: A: Right way. B: Wrong way.

developed lateral roots (*vide* figs. 2A and 2B). Plants with badly bent taproots (usually the result of bad pricking out) should be thrown away, as sooner or later they will fail in the field.

The smaller the plant set out—say down to 3 inches—the greater are the chances of success, in that there is a smaller root system to disturb and less shock from which to recover when the roots are struggling to establish themselves in their new environment.

It often happens, when favourable planting weather is long delayed, that eucalypts and other fast-growing, broad-leaved trees have reached an alarming size by the time planting is possible. In such cases it is usually advisable to cut back the plants to leave about 6 inches of stem, which may have a few or no leaves remaining. Immediately before actual planting, the root systems should be correspondingly shortened.

When suckers, *e.g.*, of poplar or bamboo, are set out, the same operation of cutting back should previously be carried out.

In the case of Carolina poplar cuttings raised as already described, and which should only be planted in rich moist but well drained alluvial soil, by the following August, if they are in good rich soil they will have developed into long straight plants about 6 ft. in length. These are then planted out in the field and the leaders cut off at ground level. (These leaders are in turn converted into cuttings.) If convenient a couple of gallons of water are given to each as it is planted.

Any double leader which may develop later is removed during the dormant season.

Planting Methods.—

(*a*) *With Balls of Earth.*—The most common practice in this Colony is to use plants which have previously been pricked out into tins or trays, usually 25 to 30 in a tin.

The tins should be carried to the planting site and well watered. As each tin is to be used, it will facilitate removal of the plants if a sharp knife is drawn between the rows, both

across and along the tin. The knife should pierce the soil to the bottom of the tin and also sever the interlacing roots. In this manner each plant stands by itself in a cube of earth. After the removal of the first cube—in any corner of the tin —the remaining plants are easily removed in succession (*vide* figs. 1A and 1B).

A hole is made in the planting site—by means of a hoe, trowel or flat-pointed stick—slightly larger than is sufficient to receive the ball of earth containing the plant. In removing the ball of earth, a rapid examination for a bad root system should be made, and care should be taken that the earth is not squeezed tightly round the roots.

The ball of earth is held firmly against one side of the hole, so that the base of the stem is on a level with the top of the hole; on no account should the plant be set any deeper. Mother earth is then firmly tamped all round the ball of earth, so that absolute contact is assured. No air spaces must be left, especially at the bottom of the hole. The soil is then firmed down by pressure of the feet, care being taken that no soil is piled above the collar of the plant. If practicable, a little water should be given to the plant to settle it in the soil (*vide* figs. 3A and 3B).

If the ball of earth becomes detached from the roots, the method of open-rooted plants should be followed.

(*b*) *Open-Rooted Plants* (*without Balls of Earth*).—The setting out of open-rooted plants is carried out in the case of seedlings which are removed direct from the nursery beds, when no pricking out has been done, or in the case of transplants, from transplant beds, when the cost of transport to the planting site is a big consideration.

The seedlings or transplants are removed from the beds with a fork or spade in such a manner that the minimum of damage is done to the roots. The plants are packed in a tin containing a sloppy mixture of dung and mud, or sometimes —though this is not advisable in the tree-veld zones—in wet sacks or bags containing some moist moss or other vegetable matter. *On no account should the plants be pulled from the beds, as this results in leaving the most important roots behind.*

At the planting site a hole is made with a hoe, spade or trowel, slightly deeper than the length of the root system of the plant. The plant is removed from the tin or sack and placed well into the hole. Earth is placed on the bottom of the root, and the plant is then gradually drawn up until the collar is on a level with the top of the hole.

During this operation, which ensures the straightening out of the roots and the natural spreading of the whole system, earth is tamped round the roots until the hole is filled. If care is taken to start tamping at the bottom of the hole, there need be no fear of leaving air spaces to which the roots might be exposed. The soil is firmed and watered as in the method for balled plants.

A quicker method of planting is when the dibbling stick, which is pointed and of square, triangular or circular section. The soil is pierced with the stick and the plant inserted into the resulting hole in such a maner that the taproot is not bent. While the plant is being held in position, the stick is pierced obliquely into the soil a few inches from the first hole. By applying pressure to bring the stick into a vertical position, soil is pressed against the plant and the operation is complete. The disadvantage of this method is that there is no certainty that no air spaces are left at the bottom of the first hole. Many failures are accounted for in this way, especially when raw labour gangs are used in planting operations.

Various methods of planting by " notching " are sometimes used, especially in soils whose texture will allow of a clean cut. "T-notching" is the most common, and is carried out by means of a spade. The spade is inserted into the soil to a depth commensurate with the length of the root of the plant. At one end of the notch or slit so formed the spade is again inserted at right angles. The spade is then tilted back, with the result that the first notch opens out. The plant is then placed in the gap and the spade withdrawn. The earth will tend to subside into its original position, but assistance should be given by pressure of the feet to ensure that no air spaces are left.

In the tree-veld zones the dibbling and notching methods are not advocated. Skill and understanding are needed in carrying out the operations. In any case, the roots assume an unnatural position in the soil, and in a country where tree planting is fraught with numerous pitfalls, any method which is inimical to the formation of a normal root system should be avoided.

All methods of setting out open-rooted plants are subject to appreciable failures, namely, by reason of the fact that roots are more liable to exposure to the air than when balled plants are used. Unless, therefore, keen supervision of planting is exercised, it may well be that the initial low cost of such operations will, by reason of repeated subsequent filling of blanks, eventually equal the expense which would have been incurred by planting with balls of earth.

With sufficient space it would be easy to show that faulty nutrition has played a large part in inhibiting human progress, and even to show that few races have at any time been ideally nourished.—*Sir Frederick Gowland Hopkins.*

Southern Rhodesia Veterinary Report.

JUNE, 1941.

DISEASES.

No fresh outbreaks.

TUBERCULIN TEST.

Fifteen bulls, 39 cows and 15 heifers were tested on importation. There were no reactors.

MALLEIN TEST.

Eleven horses and 16 donkeys were tested with negative results.

IMPORTATIONS.

Union of South Africa.—Cows, heifers and calves, 54; bulls, 15; horses, 11; sheep, 909.

Bechuanaland Protectorate.—Slaughter cattle, 194; sheep and goats, 715; pigs, 38.

EXPORTATIONS.

Portuguese East Africa.—Slaughter cattle, 96.

Northern Rhodesia.—Goats, 64.

Belgian Congo.—Donkeys, 16; pigs, 139.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

United Kingdom.—Beef quarters (chilled quality), 7,352; buttocks, 975; boneless beef quarters, 2,598; tongues, 18,979 lbs.; livers, 15,060 lbs.; tails, 13,580 lbs.; skirts, 8,052 lbs.; tongue roots, 17,227 lbs.; hearts, 4,995 lbs.; cheeks, 4,524 lbs.; fillets, 4,161 lbs.

Northern Rhodesia.—Beef carcases, 217; mutton carcases, 37; pork carcases, 24; veal carcases, 3; offal, 8,335 lbs.

Belgian Congo.—Beef carcases, 80; pork carcases, 60; offal, 1,227 lbs.

Meat Products from Liebig's Factory, West Nicholson.

Union of South Africa.—Corned beef, 628,298 lbs.; tongues, 819 lbs.; Vienna sausages, 10,905 lbs.; beef and vegetable rations, 42,000 lbs.; ideal quick lunch, 1,848 lbs.; lunch rolls, 1,710 lbs.; beef and ham rolls, 1,185 lbs.; meat paste, 819 lbs.; beef fat, 76,000 lbs.

Northern Rhodesia.—Meat meal, 6,000 lbs.; bone meal, 32,000 lbs.

Belgian Congo.—Corned beef, 21,600 lbs.

Bechuanaland Protectorate.—Corned beef, 576 lbs.; bone meal, 2,000 lbs.

United Kingdom.—Meat extract, 31,186 lbs.; beef powder, 18,491 lbs.

Mauritius.—Corned Beef, 1,800 lbs.

(Sgd.) B. L. KING,
for Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-41.

Monthly Report No. 103. June, 1941.

Red Locust (*Nomadacris septemfasciata*, Serv.).—Swarms have been considerably less in evidence during June than they were in May. This is the usual experience and is probably due to the colder weather, inhibiting activity.

Swarms were reported in June in the districts of Lomagundi, Salisbury, Mazoe, Darwin, Mrewa, Inyanga, Melsetter and Gwelo.

Specimens caught in the Salisbury district were found to be infested with threadworm. Otherwise all specimens received have been healthy.

There has been no definite trend apparent in the direction of flight.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

Vol. XXXVIII.] No. 9 [September, 1941

Editorial

Notes and Comments

Star Burweed.

In the July issue of this Journal the attention of farmers was drawn to this noxious weed. It was feared that star burweed was more widespread in its incidence throughout the Colony than was at first thought. With a view to obtaining the closest co-operation of farmers and all concerned, a circular letter was sent to Farmers' Associations and to the Agricultural Unions asking for their views as to the prevalence of the weed and as to how the question of controlling or preventing its spread could best be achieved under present conditions. Up to the present only seven Farmers' Associations have replied to the Department's circular. From these replies it appears that many farmers have either never heard of the weed or are ignorant of its appearance.

It was decided to endeavour to supply Farmers' Associations with coloured illustrations of both the upright and prostrate species to assist in their identification. Through the courtesy of the Department of Agriculture and Forestry, Union of South Africa, coloured illustrations of both species have been made available and these have been issued to all Farmers' Associations and to the Police.

The Department gratefully acknowledges the kindly assistance thus accorded to Southern Rhodesia by the Union Department of Agriculture and Forestry.

A Rubber "Persuader" for Cattle.

To avoid injuring or bruising cattle in trucking yards, one beef buyer does all his urging when trucking stock with a whip made of an old motor tube, states a note in the *Queensland Agricultural Journal.* The tube is cut in sections lengthwise and mounted on a wooden handle. When the rubber whip is slapped on a beast it makes a loud report which startles the animal and produces the same effect as a powerful blow. Investigation of slaughtered cattle has shown no bruise or injury to the carcase through the used of this effective yet gentle rubber "persuader."

Bruising of beef on the hoof means a substantial reduction of the value of beef on the hook, so that the use of a harmless rubber slapper, which would do away with much unnecessary bruising, is worthy of consideration by stock-owners.

Fertiliser from Oil.

Among the many products derived from oil (petroleum), the preparation of ammonia is of interest to farmers. From oil one United States company made 4,500 tons of ammonia in 1931 and 27,000 tons in 1939. This synthetic ammonia finds its chief use on farms. On irrigated lands farmers use it as a fertiliser in liquified form, the ammonia being transported in metal cylinders and carried onto the soil with the water in the irrigation channels. On non-irrigated land it is applied in the form of sulphate of ammonia.—*National Geographic Magazine.*

Tobacco in Canada.

An article in *The Lighter* shows that self-sufficiency in tobacco production has been attained by the industry in Canada. Since 1900 the production has increased from 11,000,000 lbs. of commercial leaf to 108,000,000 lbs. valued at about 20,000,000 dollars. Since 1930 the output of flue-cured tobacco in Quebec has increased from 22,000 to 5,150,000 lbs. Cigar leaf and Quebec pipe tobaccos last year amounted to 9,300,000 lbs. valued at 920,000 dollars. Except for cigar wrappers, binders and Havana leaf, and the small

amount of Turkish leaf used for blending a few brands of cigarettes, Canada grows enough tobacco of the right kinds to supply all her needs.

Potato Silage.

The following note on the preparation of potato silage is taken from *The Farmer and Stock Breeaer.* If they are reasonably free from soil, potatoes have only to be boiled or steamed until soft and then rammed down, still hot, into some sort of silo or container. Nothing elaborate is required. Any space of suitable size could be used as a silo provided it has airtight walls which are reasonably smooth on the inside. Old bags and a layer of soil make the upper surface as nearly airtight as possible, but it must be protected from rain. If the silo is sunk in the ground, no water must seep into it. Ensilage of potatoes avoids all those losses from respiration, sprouting and disease which inevitably occur in storage.

Trials have shown that when opened after six months the silage was in excellent condition. The potatoes had gone only slightly yellow in colour. The flavour was definitely lactic, reminiscent of butter-milk. There was practically no loss from decomposition at the sides of the silo and only about two inches had to be discarded from the top. Feeding trials to pigs have also proved satisfactory, but it is recommended that the silage should be introduced into the ration gradually.

Plant Disease Control.

A desire has been expressed by farmers and other members of the public for a concise handbook on the control of the common diseases of plants in Rhodesia. It does not appear to be generally knwn that such a publication is in existence, having been issued by the Department of Agriculture in December, 1939, as No. 2 of the Departmental Memoir Series. The booklet is in the form of a complete list of plant diseases recorded in Southern Rhodesia up to June, 1939, and a summarised description of symptoms and methods of control of each disease, where these are known and practised, is added.

Since increased numbers of Europeans have turned their attention to the production of vegetables and side-line crops prominence has been given to plant diseases, which before were attributed to adverse weather or incorrect methods of cultivation. Farmers would be advised, therefore, to purchase a copy of this cheap little book in order that they may learn how to prevent the losses which they now suffer as a result of controllable plant diseases. The publication is entitled "A Descriptive List of Plant Diseases in Southern Rhodesia (and their control)" and is on sale at the Government Stationery Office, Salisbury (corner Fourth Street and Central Avenue) at the low price of 1s. post free.

Liquid Manure.

Another example of the value of farmyard manure is furnished by the Scottish Department of Agriculture, which states that the liquid manure from a herd of 40 dairy cows would in 25 weeks be worth £50, or 25s. per cow. Three and a half tons of potash salts (now almost unprocurable), two and a half tons sulphate of ammonia and half a ton of superphosphate would be necessary to supply the same quantity of plant food as is provided by the liquid manure of the 40 cows.

It is of interest to note that 50% of the nitrogen in the total excreta of cattle and 85% of the potash are voided in the urine, while most of the phosphates are excreted in the faeces. It is felt to be of the utmost importance to conserve these nutrients, particularly as they occur in solution in a readily available form.

Sales.

AGRICULTURAL EXPERIMENTAL STATION, SALISBURY.

SPINELESS CACTUS SLABS.

Delivery during September and October ... ... 100 slabs 7/6
Delivery during other months ... ... 100 slabs 12/6
(not recommended).
Varieties: Algerian, Muscatel and Nopalea.

KUDZU VINE CROWNS.

Delivery during September, October (for irrigated land).
January for "dry land" ... ... per 100 crowns 15/-

SWEET POTATOES.

Tubers—Delivery during September and October.
7/6 per petrol case.
Cuttings—Delivery during January ... ... 6/- per bag.
Varieties: Virovsky, Early Butter, Linslade, Calabash Leaf.

EDIBLE CANNA TUBERS ... ... 6/- per 75 lbs.

GRASS ROOTS.

Delivery during January ... ... 6/- per bag.
Varieties: Woolly Finger, Swamp Couch, Creeping False Paspalum, Naivasha Star and Panicum Makarikari.
Napier Fodder ... ... 10/- per bag of 200 roots.
Cow Cane ... ... 10/- per bag of 200 roots.

The above are available in limited quantities only.

Owing to pressure of other duties and wartime reduction of staff deliveries cannot be guaranteed at times other than those stated, and living plant material cannot be sent beyond the borders of this Colony.

All the above will be delivered free by rail to any station or siding in Southern Rhodesia, but the price does not include Road Motor Service charges. Cheques should be made payable to the Accountant, Department of Agriculture and Lands, and preliminary enquiries and subsequent orders should be addressed to the Agriculturist, Department of Agriculture, Salisbury. (Sept.-Jan.)

Diseases of Fruit, Flowers and Vegetables in Southern Rhodesia.

4. MILDEW OF MANGOES.

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A.,
Senior Plant Pathologist.

Description.—Mildew is a disease which is very prevalent on mangoes in Rhodesia and causes substantial losses of fruit. Many owners of trees complain of small crops and attribute the trouble to adverse weather conditions, insect pests, poor varieties and many other causes, but few appreciate the fact that the basic trouble is mildew on the blossoms. One reason why the disease is so frequently overlooked is that it does not become conspicuous until the flowering parts are destroyed or disfigured. It is then too late to apply control measures.

The first symptom of mildew is the appearance of a white powdery coating on the flower clusters at about the time when the petals open. This white, dust-like substance is composed of thousands upon thousands of minute transparent spores of the mildew fungus (*Oidium* sp.), borne in chains on slender threads which grow up from the surface of the petals and flower stalks. The fungus penetrates the outer layers of cells of the floral parts, killing the tissues, which turn a greyish colour and ultimately black. The flowers may fail to open and be shed before fertilisation or the young fruits may remain on the tree until they reach the size of a pea, when the majority of them drop.

In the more humid parts of the Colony, especially on the Eastern border, mildew may grow profusely on the new leaves, which are soon covered with a white powdery layer and become discoloured and may wither.

Conditions favouring the Disease.—No precise information has been obtained about conditions which are especially

favourable to the development of mildew, but exceptionally hot dry weather at the time of flowering appears to predispose the trees to severe infection. It is also possible that some varieties of mango are more susceptible to the disease than others but, as the majority grown in Rhodesia are seedlings, no accurate information is available regarding varietal resistance. The disease makes its appearance every year, the severity of the attack being mainly dependent on climatic conditions.

Control.—Mildew is very easily controlled by the use of sulphur dusts, but it is necessary to employ recognised horticultural products (not flowers of sulphur) if the best results are to be obtained. The sulphuring dusts marketed by fungicide manufacturers in Rhodesia are specially prepared to give a very fine cloud of particles, which are so small that they rise in the air and penetrate into all the crevices of the trees. Dusting machines are necessary for treating very large trees, but quite effective work can be done on small and medium size trees merely by shaking the dust from a muslin bag suspended on the end of a bamboo, to create a good dense cloud. Commercial growers of mangoes are advised to investigate the costs of suitable mechanical appliances but, in any case, to adopt dusting as a routine measure. Sulphur should be applied when the flower clusters have expanded and just before the flowers open, again immediately after the petals have fallen and once more when the young fruits are the size of buckshot. The treatment should be carried out in the early morning when dew is still on the trees and should not be done when a high wind is blowing. In very dry weather some growers spray the trees with water before the sulphur is applied in order to ensure the firm adherence of the fungicide.

Wet spraying with colloidal sulphur at the rate of 1 lb. to 30 gallons of water also gives satisfactory control and may be preferred by growers who have suitable spray pumps.

Dusting sulphur is marketed in Rhodesia under the name of Capex Special Sulphuring Dust and colloidal sulphur is sold as Capoidal Insecticide and Sulsol.

Empire Production of Drugs.

STRAMONIUM.

By P. J. Greenway, Systematic Botanist, East African Agricultural Research Station, Amani.

In response to enquiries received regarding the production and value of Stramonium, the following article from *The East African Agricultural Journal* is reprinted for general information:—

Introductory Note.—Last October the Medical Research Council of Great Britain issued a list of drugs for the guidance of those concerned with the compilation of formularies and those responsible for drug manufacture and distribution. The Council's main object was to examine the lists of the drugs which are imported into Great Britain and to recommend substitutes that can be obtained at home or within the British Empire.

Stramonium is one of the drugs listed by the Medical Research Council, and, judging from reports received from England, growers there are being encouraged to increase production along with other drugs such as henbane and belladonna, which are also considered as essential. British supplies of stramonium were mainly derived from Germany, France and Hungary.

The genus *Datura,* to which stramonium, or thorn apple, belongs, is represented by about eight species in East Africa. Of these about four are escapes and have now become naturalised; the others, which include the "Moon Flower" or "Angel's Tears," are commonly found in gardens at the higher altitudes.

Datura Stramonium L., from which the drug stramonium is obtained, is an erect, branched annual herb up to about 4 ft. tall. The leaves are alternate, stalked, roughly

triangular in outline with the margins coarsely lobed or toothed; in the forks of the branches a leaf and a solitary flower with tubular calyx and large white funnel-shaped corolla are produced. The fruit is an oblong spiny capsule, about 2 in. long, opening by four valves; the numerous seeds are dark-brown or black, kidney-shaped, with net markings. *Datura Tatula* L., another source of stramonium, is a closely related plant with purple stems and leaf-stalks and dirty purplish flowers. It is perhaps only a form of *D. Stramonium*, with which it is often found.

Distribution.—Both plants are found as local weeds in East Africa, from about 3,000 ft. upwards, *D. Stramonium* being the most common. In places in Tanganyika it is a pioneer species in recently abandoned rye fields, European vegetable gardens and to a certain extent in native gardens, especially near huts. It has been observed in quantity in shallow roadside drains on volcanic soils in Kenya.

It is thought to be a native of the shores of the Caspian Sea, but is found commonly on wast ground throughout the temperate and warmer regions, and is abundant in South Africa.

Cultivation.—Stramonium likes a rich well-drained soil. The land in which it is to be cultivated should be well and deeply dug or ploughed and cleared of all weeds. The seeds should be thinly drilled in rows 2 ft. 6 in. apart, or sown broadcast very thinly, and lightly harrowed. When large enough the seedlings should be thinned to 8 to 12 in. apart in the rows, but if broadcast the spacing should be wider. During growth the land should be kept weeded.

Harvesting.—The drug stramonium consists of the dried leaves and flowering tops of the plant, collected when in flower. Curing consists only of careful drying. This should be done as quickly as possible by exposing the leaves and tops to the air in a shady place or by placing them in an artificially heated drying room at about 100° F. They should only be dried sufficiently to prevent them from going mouldy in transit. A yield of 700 lbs. of dried leaves per acre has easily been obtained in Kenya.

In the properly prepared product the leaves should be dark-greyish green, much shrivelled and twisted as the result of the drying. The odour of the drug is not strong, but characteristic, and the taste unpleasantly bitter.

For export the dried product is generally packed in hessian bags or bales of 56 or 112lbs.

Standard Required.—To conform to British Pharmaceutical Standards, the drug stramonium should contain not more than 2 per cent. of foreign organic matter, not more than 20 per cent. of its stem, not more than 1 per cent. of its stem having a width greater than 4 mm., and not less than 0.25 per cent. of the alkaloids of stramonium calculated as hyoscyamine. Ash, not more than 20 per cent. Acid-insoluble ash, not more than 4 per cent.

The seeds of *D. Stramonium* and *D. Tatula* are also acceptable to the British Phamacopœia.

Uses.—The drug is chiefly used to relieve the spasmodic contractions of the bronchioles in asthma. *D. Stramonium* is also one of the chief sources of the alkaloid hyoscine, which is much used as a hypnotic, especially in mania, and in cerebral excitement, such as occurs in alcoholism. As a rule, hyoscine produces a sensation of fatigue and drowsiness, which is quickly followed by sleep. *D. Stramonium* and another, *D. Metel* L., are used for chest complaints by the natives, the flowers and leaves being smoked in cigarettes, which have a drugging effect. The seeds are narcotic and are put into native beer to make it more intoxicating. They are also used for criminal poisoning. A green dye is obtained from both plants.

Market Quotations.—At the time of writing the lost open-market quotation for stramonium leaves is for the end of December, 1940, when in London there were offers of Continental at Sh. 130 per cwt. ex store duty paid (nominal) and Indian at Sh. 80, duty free. In New York, 0.35 to 0.40 dollars per lb. for Continental stramonium leaves, and 0.30 to 0.35 dollars per lb. for seeds.

Soya Beans.

RESULTS OF TRIALS SEASON 1940-41.

By H. C. Arnold, Manager, Salisbury Experiment Station.

In soya beans nature has provided proteins, oils and vitamins as well as other nutrients and has combined them in a form which allows them to be stored and transported more economically than is possible with any other form of produce which it is possible to grow on a large scale in this Colony, but whether they will be found more profitable to grow than maize for export has yet to be determined.

It is the purpose of these notes to report the results of experiments conducted at this Station. Information obtained from farmers who were supplied with small parcels of seed at the beginning of the season is included.

On the whole the season was exceptionally unfavourable for growing plants and lower yields were obtained than in previous years. During the early part of November normal rains were precipitated, and by the twenty-third day of that month the total rainfall had reached 5 inches. From November 24th to December 21st no rain fell at all. Consequently early sown crops were obliged to endure a long period of drought soon after the seed germinated. The seed which was sown during the latter part of November rotted in the ground owing to the lack of sufficient moisture to complete its germination. Satisfactory germination was secured by sowing later but the plants did not fully develop owing to their growth period being curtailed through the early cessation of the rains.

The severity of the season has served a useful purpose by demonstrating beyond doubt that, provided there is sufficient moisture in the soil to ensure germination, soya beans are able to withstand droughty conditions quite as well as maize.

Fertiliser Trials. Sown 9/12/40, reaped 23/4/41. Variety Potchefstroom No. 184.—This trial included dressings of phosphate and muriate of potash alone and also combined. The dressings were replicated eight times. The fertilised plots did not yield heavier crops than the unfertilised control plots. The ineffectiveness of the fertiliser may have been largely due to the unfavourable weather conditions, but this experiment will need to be repeated over a number of seasons before definite conclusions can be drawn.

Distance-planting Trials. Sown 28/12/40, reaped 13/5/41. Variety Hernon No. 268.—The plan of this experiment was the same as that of previous years, but the variety of soya bean was different, namely, Hernon No. 268. This variety was used because in the previous season's variety trials it yielded considerably more than Potchefstroom No. 184, which until that time was our best yielding strain. The distances between rows were 12 inches, 18 inches and 24 inches respectively, and the distance between seeds in the row 4 inches. The treatments were replicated twelve times. The results obtained in these trials over a period of three years are tabulated below:—

YIELDS OF SEED IN LBS. PER ACRE.

Season.	Variety	Rows 12 ins. apart.	Rows 18 ins. apart.	Rows 24 ins. apart.	Difference between 12 in. & 24 in. spacings.
1938-39	Mammoth	759	614	627	21%
1939-40	Pot. No. 184	1,485	1,408	1,307	14%
1940-41	Hernon No. 268	1,089	1,054	980	11%

The trials this season support those of the previous years, but the difference in favour of the closest spacing is not as much this season as it was in those years. This may be due to the droughty conditions which prevailed toward the end of the season but is probably partly due to the robust habit of growth of the Hernon variety which enabled it to make better use of the wider spacings than the older varieties.

This trial serves to show that close spacing conduces to heavy yields, but in field practice the most profitable spacing will be the one which allows the necessary weeding to be done economically, in addition to returning a heavy yield.

Strain Trials.—During recent years new strains of the yellow-seeded kinds have been introduced which are better in every way than the strains we had as little as five years ago. One of these superior strains is known as Potchefstroom No. 184, because it originated at the Potchefstroom School of Agriculture. At least ten other Potchefstroom strains have been tested at this Station. None of them yielded as well as No. 184, and some gave very poor yields. In addition to the trials made at this Station, seed of the most promising Potchefstroom strains have been sent to several farmers, embracing such widely separated districts as Fort Victoria, Nyamandhlovu, Arcturus and Shamva. In every case No. 184 proved to be the best yielder. It also retains its seed for a longer period than any other strain.

As a result of crossing a non-shattering yellow-seeded strain with the Otoxi and Herman varieties, several new "Hernon" strains have been obtained which combine the good qualities of both parents. In carefully conducted trials during the past two seasons the best of these have consistently yielded more heavily than Potchefstroom No. 184. Each of these strains was derived from a single plant.

During the first season or two the trials were laid down on well manured soil with a view to increasing the production of seed as quickly as possible. When enough seed had been produced it was possible to extend the trials to include different classes of soil. Hence in the season 1939-1940 the trials were made on land which had been kraal-manured in the previous year, but in the season 1940-41 they were conducted on comparatively poor soil. This, coupled with unfavourable weather conditions, accounts for the lower yields recorded below. In the following tabulation the yields of seed are shown in pounds per acre, and the difference in favour of the Hernon strains is shown as a percentage of the P. No. 184 yield in the same trials.

Hernon Strains compared with P. No. 184.

YIELDS OF SEED IN LBS. PER ACRE.

Strain.	Season 1940-41. lbs. per acre.	Season 1940-41. Percentage above P. No. 184	Season 1939-40. lbs. per acre.	Season 1939-40. Percentage above P. No. 184
Potchefstroom No. 184	1,334	—	525	—
Hernon No. 5	1,800	35	625	19
Hernon No. 18	1,650	23	714	36
Hernon No. 29	1,581	11	656	24
Hernon No. 36	1,625	22	672	28
Hernon No. 39	1,840	38	696	33
Hernon No. 107	—	54	828	58
Hernon No. 268	1,540	16	710	35

In the season 1939-40 the seed of No. 107 was insufficient for sowing in the main trial plots, but in smaller plots with four replications it yielded at the rate of 2,385 lbs. per acre and in the same series P.184 gave 1,553 lbs. per acre.

These results show that the Hernon strains are able to produce larger amounts of seed than the Potchefstroom strain under both favourable and adverse soil and weather conditions. The difference is a very substantial one and it may amount to as much as two or three bags per acre on fertile land.

With the exception of No. 29 the Hernon strains require from 14 to 20 days longer to reach maturity than P. No. 184, and for this reason in order to obtain the best results they should be sown before the middle of December. If sowing is delayed until the end of December and January they may not have time to complete their normal growth and a reduced crop will result unless the rains continue until the end of March or later. In general when sowing is delayed as late as January the early maturing varieties P. No. 184 and Hernon No. 29 will yield as heavily as the other Hernon strains. Hernon No. 29 requires only six days longer than P. No. 184 to reach maturity, but it produces a considerably heavier crop of seed. The main distinguishing characteristics of the best Hernon strains and P. No. 184 are given in the following tabulation:—

Soya Bean. Jubiltan Strain. Grown at Veterinary Research Laboratories. Season 1940-41. This crop yielded over three tons per acre of very palatable and highly nutritious hay. The colour of the seed coat of the Jubiltan strains makes them unsuited for human consumption, but they produce larger quantities of fodder than the yellow-seeded kinds.

Soya Bean. Hernon 268. Grown at the Agricultural Experiment Station, Salisbury. Season 1940-41. This variety has edible yellow seed which is suited for industrial purposes. Its robust habit of growth allows it to be used for hay if desired.

Name.	Colour, leaves, stems and pubescense.	Approx. period between sowing and reaping.	Height.	Colour and shape of seed.
P. No. 184	Grey	110	18″ to 24″	Light yellow, large round.
Hernon No. 5	Brown	124	24″ to 30″	Glossy yellow, small kidney.
Hernon No. 18	Grey	130	30″ to 38″	Light yellow, small kidney.
Hernon No. 29	Grey	116	20″ to 38″	Dull yellow, small round.
Hernon No. 36	Brown	124	24″ to 30″	Glossy yellow, small kidney.
Hernon No. 39	Brown	130	24″ to 30″	Glossy yellow, small kidney.
Hernon No. 107	Grey	128	30″ to 36″	Dull yellow, large kidney.
Hernon No. 268	Grey	128	30″ to 36″	Dull yellow, large kidney.

The Hernon strains are not entirely homogeneous and it may be found that a few plants with dark coloured seed will appear. Growers who wish to use their crop as seed or intend to dispose of it for that purpose should inspect the crop in the field and remove all plants which are not true to type. This operation is less difficult when the variety has grey stems, because all "off-type" plants with brown stems can be easily detected and removed before the crop is reaped. Although a small proportion of dark-coloured beans may not reduce the commercial value of the crop, all brown and black beans should be removed from the seed before it is sown in order that the creamy yellow colour normal to these strains may be maintained.

At the beginning of last season small quantities of these Hernon strains were sent to several farmers in various parts of the Colony in addition to P. No. 184. In nearly every case the recipients reported very considerably heavier yields from the Hernon strains even though, in some cases, sowing was delayed until the first week in January. Two enthusiastic farmers who kraal-manured and fertilised their crops well, sowed early and irrigated once or twice during the droughty period obtained yields at the rate of ten to twelve bags per acre. In one instance where only half a pound of seed was sown, a yield of 121 lbs. of beans was reaped.

The Hernon strains are more robust than P. No. 184 and they could be used for the production of hay if desired. The yield of hay would probably be somewhat less than that of

the Jubiltan strains, but by growing a yellow seeded variety the farmer would be able to use his crop for hay if the vagaries of the season caused a shortage of other hay crops. Alternatively if the season proved favourable for other fodder crops the yellow soya beans could be reaped as grain and marketed in that form for milling purposes.

Four unnamed varieties of yellow-seeded soya beans which were offered for sale by local seedsmen were included in our trials, and it was found that all of them were definitely less prolific than P. No. 184.

The past years' investigational work, therefore, indicates that the only yellow-seeded varieties of soya beans which are likely to yield profitable crops at the market rates now ruling are Potchefstroom No. 184 and the Hernon strains. Seed of these strains is available for issue in small quantities to bona fide farmers in this Colony under our co-operative experiment scheme. This provides for the supply of seed free of cost by the Government, f.o.r. Salisbury. Transport charges are borne by the consignee. At the end of the season the farmer sends in a report on the form provided for that purpose, stating cultural methods employed and the yield of the crop. By this means the Agricultural Department obtains valuable information as to the suitability of crops to various districts and the farmers obtain information about new crops or new varieties of old crops, and they are also sure of getting correctly named planting material. Seed supplied under this scheme is usually sown under the normal field conditions suited for production on a commercial scale. This practice may be followed by those who receive issues of soya beans, but it may be pointed out that larger quantities of seed can be obtained from the small quantity supplied if more space is allowed the individual plants in order that each can make its maximum growth. It is suggested that P. No. 184 should be sown at the usual spacing of 18 ins. x 4 ins. or 30 ins. x 3 ins., but that, owing to the very small amount of Hernon seed available and the advisability of increasing it as quickly as possible, it should be sown at a spacing which will allow two or more square feet per plant, and on land which has been liberally manured and fertilised. By sowing it in this

way each pound of seed will cover one-sixth to one-fourth of an acre of land and yield approximately 200 lbs., or even more, under very favourable conditions.

Farmers who wish to use their bean crops for native rations should grow either No. 18 or No. 36, as the texture of the cooked seed of these strains is somewhat "softer" than that of the others. In other respects, Nos. 5 and 36 are almost identical. No. 107 is derived from a single plant selection out of No. 268 and it resembles the parent variety very closely in regard to habit and period of growth, but it has out-yielded the parent strain during the past two years and it will supersede No. 268 in future trials at this Station.

Palatability Trials.—Although soya beans can be used for industrial purposes, it is thought that higher prices will be obtained for the portion of the crop which is used for human consumption. In order to ascertain their relative merits when cooked, some forty different strains have been subjected to cooking tests. It was found that, although all have a "nutty" texture in contrast to the "mushy" texture found in other varieties of beans, some of the Hernon strains, namely Nos. 18 and 36, had a larger proportion of "soft" beans than the others, and these are definitely "softer" than P. No. 184 Among the other Hernon strains, some had a proportion of soft beans while the remainder were "nutty." In a few cases about 2% of the beans were found to be as small and hard after $2\frac{1}{2}$ hours' boiling as they were before treatment. Soaking all night was found to reduce the period required for boiling, but even after immersion for 24 hours in unheated water when the room temperature was 58° F., nearly all of the varieties were found to contain a proportion of seed which were impervious to "cold" water; P. No. 184 with 3% and Hernon No. 39 with 45% were the extremes in this respect.

Imported edible varieties such as Easy-cook, Herman, Hayto, Mammoth and Rokuson were included in these tests and it was found that they were not in any way superior to P. No. 184 and the Hernon strains.

Boiling Hernon No. 268 for various periods was also tried The beans were pre-soaked for 14 hours. The first water was poured off and cold, salted water was added. About fifteen

minutes was required to raise the water to boiling point. After boiling for 1¼ hours the beans were found to be cooked, though still somewhat hard. After two hours' boiling some were still hard while others were soft, and another hour's cooking was required to soften the whole lot. Boiling was continued for another hour and by the end of that time several of the beans had split open owing to their skins becoming detached, thus both appearance and flavour were somewhat impaired.

In another series in which Hernon No. 18 was compared with kaffir beans, Canadian Wonder and Natal Sugar haricot beans, all were boiled for 1½ hours after pre-soaking for fifteen hours. The soya and kaffir beans were found to be well cooked but the time allowed was insufficient to render either of the two varieties of haricot beans palatable. It is seen, therefore, that, owing probably to their smaller size, the soya beans can be cooked with less fuel than these somewhat large-seeded strains of haricot beans.

Fairly large quantities of kaffir beans and haricots are used in this Colony in natives' rations. In certain seasons supplies of the former are insufficient to meet market demands and the difficulty of handling the crop makes the seed of the latter expensive. The merits of soya beans as food and the ease with which the crop can be cultivated suggest that the mines and other employers of native labour may eventually purchase large quantities of them. The chief obstacle to be overcome is the innate prejudice which natives have against any new kind of foodstuff. At this Station little difficulty in breaking down this prejudice was experienced. During the cooking tests several Europeans ate the beans and freely expressed a liking for them. The curiosity of native employees was thus aroused and they were given some to taste. Next about 5% of soya beans were mixed with their ration of kaffir beans. At first the majority said they didn't care for the soya beans, and when asked the reason they said it was because they needed such a lot of cooking. They preferred kaffir beans because they could be reduced to a pulp in less time. In spite of this, the soya beans were not rejected. After the first six weeks the proportion of soyas was gradually increased until at the end of the sixth month the bean ration consisted of soya beans and kaffir beans in equal proportions. A marked change in our native employees attitude toward

soya beans is now apparent. Their prejudice against soya beans has vanished and they now eat them parched or toasted as well as boiled. Seeing that soya beans can be cooked in less time than haricot beans it would seem that employers who wish to introduce the former into their natives' rations would have no difficulty in breaking down any prejudice they might encounter at first if they commenced by mixing a small proportion with the haricot bean ration.

COMPARISON OF YIELDS OF SOYA BEANS WITH THOSE OF MAIZE.

Experience in this Colony as well as other countries has shown that in general, the soil and climatic conditions required by soya beans are similar to those of maize. Farmers who have land and equipment suitable for maize cultivation will wish to know whether soya beans are likely to prove more profitable than the production of maize. So far no investigations have been laid down with the object of finding the relative yields of maize and soya beans, but observations which it is thought may throw some light on the question have been made.

The plots in Crop Rotations F. and H. which were commenced in the season 1919-20 when maize was the principal crop throughout this Colony were sub-divided this season. On the southern side the old rotations will continue as in the past, but soya beans have been introduced on the northern sub-divisions and in future they will alternate with the maize, in order that the rotational effect of soya beans may be compared with that of maize.

In both of the original rotations three crops of maize were grown in the four-year cycle. The manurial treatment in Rotation F. consists of one dressing of 8 tons of farmyard manure per acre and one of 200 lbs. superphosphate per acre, while in Rotation H. it is one crop of velvet beans ploughed under and two dressings of 200 lbs. each of phosphatic fertiliser per acre.

The following tabulations show the manurial treatment of each of the plots during the past four years and the yields of maize and/or soya beans obtained during the season just closed.

MANURIAL TREATMENTS AND YIELDS IN BAGS (200 LBS.) PER ACRE.

Soya bean variety P.No.184. FYM=Farmyard manure.
G.M.=Green manure.

ROTATION F.

Manurial Treatments.

Seasons.	Plot B.	Plot C.	Plot D.	Plot E.
1937-38	Sudan hay	Nil	F.Y.M.	Supers
1938-39	Supers	Sudan	Nil.	F.Y.M.
1939-40	F.Y.M.	Supers	Sudan	Nil
1940-41	Nil	F.Y.M.	Supers	Sudan

YIELDS IN BAGS (200 LBS.) PER ACRE.

1940-41 Old Rot.	Maize 10.53	Maize 10.55	Maize 7.60	Sudan grass
,, New Rot.	Maize 10.73	Soyas 5.76	Maize 8.73	Soyas 4.90

ROTATION H.

Manurial Treatments.

Seasons.	Plot G.	Plot H.	Plot J.	Plot K
1937-38	G.M.	Supers	Nil	Rock phos.
1938-39	Rock phos.	G.M.	Supers	Nil
1939-40	Nil	Rock phos.	G.M.	Supers
1940-41	Supers	Nil	Rock phos.	G.M.

YIELDS IN BAGS (200 LBS.) PER ACRE.

1940-41 Old Rot.	Maize 9.40	Maize 8.10	Maize 20.65	G.M.
,, New Rot.	Maize 10.88	Soyas 2.32	Maize 20.38	Soyas 2.20

The beneficial effect of farmyard manure on the yield of soya beans is strikingly shown in these trials. In Rotation F., plot C., the soya bean yield is more than 50% of the maize yield, and on plot E. the bean yield would probably have compared as well had maize taken the place of Sudan grass on the other half of the plot. The yields indicate that the maize crop on plot C. has not made full use of the farmyard manure which was applied this season, but that the soya beans have been able to make better use of it. Although the maize yields in Rotation H., plots G. and H., are nearly as

high as those in Rotation F., the soya bean yields are less than half as much, and are only one quarter of the maize yields on the adjoining plots.

Previous experiments carried out on this Station tend to indicate that legumes respond much better to applications of farmyard manure and compost than maize. This may be due to biological agencies present in the manure which may be required to a much larger extent by legumes than by cereal crops.

These results appear to corroborate the observations made in the season 1938-39 when samples of soil analysed by the Chief Chemist indicated that the heavier yields of soya beans recorded on certain plots were due to their higher humus content. Comparison of the maize yields in the two rotations indicate that the benefit which the green manure confers on the maize is nearly all utilised by the first crop. According to the above results the yields indicate that the effect of the farmyard manure is not so great in the first season but its effect continues for a longer period than does that of green manure. These results and reports received from farmers also indicate that soya beans are not likely to prove more profitable than maize on land which is naturally poor in humus, or whose fertility has been reduced through being cropped continuously without humus additions, but that on land which has received adequate dressings of farmyard manure or compost soya beans may prove a very profitable crop. From the evidence available so far, it appears that soya beans will be a useful addition to farming systems which include livestock as well as crops. The plant residues remaining after the crop is threshed are more valuable for stock feed than maize residues. These results suggest that animal manure, particularly if it is not thoroughly rotted down before it is applied to the land, can be converted into a marketable commodity more quickly by means of the soya bean crop than is possible with the maize crop.

JUBILTAN STRAINS.

These strains have again proved their superiority over other kinds when the production of fodder is the object in view. Although their production of seed is not as great as

that of the yellow-seeded strains when it is measured in bags per acre, owing to its smaller size and the robust habit of growth of the plants, a bag of Jubiltan seed will re-sow twice as much land as a bag of the yellow kinds. The Jubiltan seed produced on an acre of land will re-sow 50% more land than the seed produced by the yellow kinds on a similar area. In addition to lower costs per acre for seed their yield of fodder is very considerably greater than that of the yellow kinds. In one particular only is their cultivation more difficult than that of the yellows, and this is because they require a longer season to reach maturity. They require about one month longer to mature a full seed crop than the Hernon strains, and for that reason they should be sown during the month of November when the crop is required for the production of seed; but when hay is the object, later sowing can be practised because the crop will be cut for hay before its seed reaches maturity.

These strains are also greatly benefited by applications of farmyard manure or compost. The accompanying photograph is of a crop grown this season at the Veterinary Research Laboratories, Salisbury, on manured land. The yield exceeded three tons of hay per acre. Crops similar to this have been produced each year for the past six years at this Institution and during that period the hay has been fed to all classes of animals and has proved to be equal to the best lucerne hay. Several owners of horses in the Salisbury district are now using soya bean hay for their animals. They find it is much liked by the horses and that no fodder is better for maintaining them in satisfactory condition.

It is seen, therefore, that although the yellow-seeded kinds are the only ones suitable for humans or for industrial concerns which convert the beans into products for human consumption, farmers who intend to use their crops as cattle feed will find the Jubiltan strains more economical than the yellow-seeded varieties.

Tobacco Culture in Southern Rhodesia.

SEED-BEDS.

By D. D. Brown, Chief Tobacco Officer.

The seed-beds are the foundation of the crop and consequently the greatest care should be exercised in the selection of a suitable site and in the preparation and management of the seed-beds. Failure to prepare properly and handle the seed-beds intelligently may be the cause of great inconvenience at the time of transplanting, and in some cases may mean the failure of a crop through lack of plants. One of the prime essentials in producing a good crop of tobacco of any type is to have a sufficient quantity of well developed, strong, healthy plants and, in order to produce suitable seedlings, unremitting care and attention are called for on the part of the grower.

Selection of Site.--Careful consideration should be given to the selection of a suitable site for the seed-beds. The area selected should, if possible, be well sheltered from the prevailing winds, for seed-beds placed in an exposed position not only require more watering, but the young plants do not thrive as they should. It is essential that the site should be near a permanent and uncontaminated water supply. Large trees should not be too near the seed-beds, as their roots would deprive the plants of food and moisture, and might interfere with the growth of the seedlings by casting too much shade.

A site having a good exposure to the sun is preferable, as this will influence the growth of the seedlings. The beds should be arranged so that the young plants may have the maximum amount of sunlight, the early morning sunlight being especially beneficial. An eastern or north-eastern exposure is best.

In order to ensure the maximum supervision the tobacco seed-beds should be as near the homestead as possible. The proximity to the homestead will necessarily be governed by such considerations as suitability of soil, water supply and shelter. If possible, the beds should also be reasonably close to the fields. It may be necessary to erect an artificial windbreak.

A simply-constructed shelter is made by placing posts at each corner of the seed-bed area and stretching two strands of fencing wire round to each post. The lower wire should be about one foot from ground level and the upper wire a little below the level of the top of the windbreak. The wires should be supported by other posts placed at intervals between the corner posts. Long grass, reeds or maize stalks are next placed in an upright position against the wires and firmly laced to the upper and lower strands. A gateway should be left in one side of the fence, preferably on that side away from the prevailing winds. A wide margin of cleared ground should be left on the outside of the windbreak to reduce the risk of fire and the entry of insect pests, which are liable to attack the tobacco plants.

The area selected should not be on a steep slope. When it is not possible to have a fairly level site, the beds may be arranged in terraces on slightly sloping ground. In the latter case it will be necessary to dig a drain above the site in order to prevent any rush of water flowing down the slope and over the beds during the rains. Good drainage should be provided for wherever the grower fears any possibility of damage due to a rush of water during rain storms.

Soil.—The most suitable soils for seed-beds are sandy loams and alluvial soils which have a plentiful supply of humus and are naturally well drained, friable and fertile. It may not always be possible to find an ideal type of soil on a suitable seed-bed site, and when this is the case much can be done to change the texture of the soil so that it may be used for seed-beds. Should the soil be too light and friable, a few wagon loads of heavier soil or ant-heap can be spread over the surface of the site and thoroughly mixed with the soil. If the soil of the area is too heavy and stiff, a similar application of sand will improve the texture and render such

soils more suitable for raising tobacco seedlings. Care must be taken not to apply nematode-infested soil to the seed-bed site.

The beds for the early sowing may be situated on the edge of a vlei, provided the soil is not too cold, but such locations should be avoided for later sowings, as during the rains vlei soils become water-logged. On many farms the soil near the only available water supply is inclined to be too wet. In such cases the only alternative is to provide adequate drainage. Time and money should not be spared to provide proper drainage, as the season's supply of seedlings may depend on the proper construction of the drains. Speaking generally open drains of sufficient width and depth to drain the site thoroughly should be cut around the four sides and, in addition, a channel must be cut from the lowest corner to lead away all drainage water. In order to prevent the sides of the drain from caving in, they should be made to slope inwards so that the top of the drain is wider than the bottom. The correct angle at which to cut the sides of the drains is determined according to the nature of the soil. For general purposes, however, the slope of the sides should be about 1 to 1 and not less than $\frac{1}{2}$ to 1. For example, a drain having a depth of four feet and a bed width of two feet would have a surface width of ten feet on the basis of 1 to 1 and a surface width of six feet on the basis of $\frac{1}{2}$ to 1.

Negligence in the matter of drainage may be the cause of failure in the production of tobacco seedlings. This applies to Turkish tobacco seed-beds more particularly, as they are sown later in the season when the rainfall is heavy. Where artificial shelters are to be erected around the beds, space should be left for them between the trenches and the seed-bed area.

An area should not be used for seed-beds more frequently than once in every four or five years. When the same site is used annually, the seedlings are more liable to the attacks of insects and fungus and bacterial diseases. The soil is also rendered less suitable through the heavy applications of water and the annual sterilising. New land is preferable for tobacco

seed-beds, as weeds and grass are less troublesome and the seedlings are not so much subject to the attacks of insect pests and plant diseases.

Preparation of Seed-beds.—The preliminary preparation consists in clearing the site of undergrowth and rubbish and levelling the land. The area cleared should be in excess of the actual area required for beds, so that a cleared space will be left round the seed-beds. This work is best carried out during the winter months and some time previous to the final preparation of the beds. The soil should receive an application of kraal manure or compost. Where kraal manure is to be used, a liberal application of old well-rotted, pulverised manure should be broadcast over the site and should be well incorporated with the soil by ploughing or spading. Kraal manure should be applied some time before the final preparation of the seed-beds in order that it may be thoroughly decomposed and converted into humus before the beds are seeded. After this the soil should be worked at frequent intervals to destroy most of the weeds before the final preparation of the beds and the remainder will be killed when the soil is sterilised. Compost, used in the place of kraal manure, is applied to the seed-beds after they have been sterilised.

In the final preparation, a short while before the date of seeding, the site is lined off into beds with pathways between. The dimensions of the beds can be arranged to suit the site and the convenience of the grower. Beds can be made any desired length, but it is best to restrict the width to three to five feet so that the middle of the beds may be easily reached from the pathway on either side. When the beds are too wide, difficulty is experienced in weeding and also in removing transplants without damage to those remaining in the seed-bed. The most convenient width has generally been found to be four feet. Very narrow pathways between the beds are the cause of much inconvenience and loss of time. Whenever possible, the pathways should not be made narrower than three feet; this width of path leaves sufficient room between the beds for watering, weeding and removal of plants.

After the beds are measured and marked off, the top soil in the pathway strips should be thrown up on to the adjoining

seed-bed; this operation when completed leaves the beds raised above the level of the pathways. Each bed should then be brought into a fine tilth and properly levelled prior to being sterilised.

There are several methods of sterilising the soil including steaming and burning. Steam sterilisation requires the use of a steam boiler, preferably portable, and not less than 20 h.p. capacity, two steam pans three to six feet by twelve feet by eight inches high, and some lengths of steam piping to carry steam from the boiler to the steam pan. Steam is led into the pan at a pressure of from eighty to one hundred pounds per square inch. The pressure must be maintained at eighty pounds or more throughout the steaming. The pans are inverted and placed in position over the soil to be sterilised. Steam should be applied to the first for thirty to forty minutes and then the steam is led into the second pan while the first remains in position until it has to be moved forward to the next section of seed-bed to be steamed. The pans must be weighted down to prevent the escape of steam. The open-fire method is the common practice in Southern Rhodesia and gives satisfactory results. By the burning process weed and grass seeds are destroyed and insects hibernating in the soil are killed. The brushwood, maize cobs or other material should be placed evenly over the surface of the seed-beds. The burning is best done when there is no wind blowing, so that full benefit may be derived from the heat generated by the burning material.

Tobacco stalks should not be used for sterilising seed-beds, as they may cause a fresh infection of disease, particularly wildfire and angular leaf spot. Also, when tobacco stalks alone are burned, the ash contains an excess of potash, which adversely affects germination. A layer of dry grass should be placed on the beds, and on top of the grass a layer, about six inches in depth, of maize cobs should follow. A layer of brushwood about two feet deep can be used in place of the maize cobs. This quantity of fuel should be sufficient to effect thorough sterilisation of the soil to a depth of three inches or more.

When properly sterilised the soil will have a light, dull red colour, and will be very friable and easily pulverised. A

simple test may be made by burying a potato about three inches below the surface of the soil in the seed-bed before burning, and when the potato has been cooked until the skin slips off easily, the soil has been properly sterilised. The soil should not be sterilised when saturated with water and, on the other hand, the soil should not be too dry. Best results are obtained when the soil contains just sufficient moisture for cultural operations. After they are sterilised the beds are allowed to cool before being enclosed with brick, boards, sheets of iron or by hessian suspended from a wire.

In Rhodesia the usual method is to place two courses of brick round the outer edge of the bed, the bricks being placed one on another, flat side down. A single row of bricks can also be used if placed on edge. This will require fewer bricks, but the sides of the bed will be more easily displaced. Boards and iron are not generally used, owing to expense and lack of material. Some growers have stretched a plain galvanised wire round the bed, about six inches above the level of the bed surface, and to this have sewn a strip of hessian, the lower edge being buried in the ground. The use of hessian cannot be recommended where white ants are likely to be troublesome.

After the beds are suitably enclosed, all the unburned portions of the material used for sterilising the beds should be removed. An even depth of about one half inch of ash should be left on the beds, as it is an excellent fertiliser containing carbonate of potash, the best form in which potash salts can be applied to tobacco. If more ash is present, part should be scraped off until the above quantity only remains, otherwise there is a danger of the soil becoming too alkaline for proper plant growth. An application of properly made and well screened compost should be evenly broadcast over the bed at the rate of from two to two-and-a-half petrol tins per ten square yards. The use of badly made compost is liable to have a deleterious effect on the young seedlings and may also introduce insect pests, disease and weed seeds to the beds. The compost should be made according to the simplified process modified by Timson* to suit local conditions. Compost

*S. D. Timson, M.C.: "Compost," Rhodesia Agricultural Journal, April, 1939

made from tobacco crop residues, such as primed leaf, scrap and stalks, may harbour tobacco diseases and must, therefore, not be used as the seed-beds may be contaminated.

A dressing of fertiliser may now be applied. An excellent mixture can be made up as follows:—

1 lb. superphosphate
½ lb. nitrate of soda
½ lb. sulphate of potash

Mix thoroughly.

The above quantities when mixed together are sufficient for ten square yards of seed-bed.

There are a number of reliable proprietary tobacco seed-bed fertilisers which are also recommended.

After the fertiliser has been applied, the beds should be dug over to a depth of roughly three inches. The unsterilised soil should not be brought to the surface, as weed and grass seed would be exposed which would give trouble later. Great care should be taken to mix thoroughly the ash, compost and fertiliser with the surface soil. The seed-beds should now be brought to a fine tilth by means of a hand rake, the same implement being used thoroughly to level the bed from end to end and also from side to side. When the beds are not level, there is a danger of the tobacco seed being washed down to the lower portions of the seed-bed surface, thus causing an undesirable unevenness in the stand of seedlings.

To support the seed-bed covering, a wire should be stretched down the centre of the bed. Pegs are driven in at intervals to within twelve inches of the surface, and the wire is placed on top of them. This completes the preparation necessary before the beds are seeded.

The Time for Sowing.—Seed sown early in the season will produce seedlings ready for transplanting usually in about sixty days. Later sowings generally produce seedlings in less time.

The usual time for sowing flue-cured Virgina type tobacco seed-beds is from the middle of September to the end of October. This enables the grower to produce seedlings ready

for transplanting during the months of November and December. Flue-cured tobacco should not be transplanted after the end of December, as late-planted tobacco seldom produces leaf of good quality, and curing is difficult.

Seed-beds for dark fire-cured, air-cured and sun-cured Virginia type are sown from the first week in October to the end of November. The seedlings are then ready for transplanting during the months of December and January.

Turkish type tobacco seed-beds are sown from the beginning of December to the middle of January, the crop being transplanted from the latter half of January to the end of February.

Sowing the Tobacco Seed.—On account of the small size of tobacco seed there is a tendency, by growers who do not realise the numbers of seed contained in a given quantity, to sow the beds too thickly. Contained in one ounce there are approximately three hundred thousand seeds, and an average teaspoon will hold about twenty-five thousand when level full.

When shelled from the seed-pods, tobacco seed contains a high percentage of inferior seeds, besides a certain amount of dust and chaff. Before sowing, these impurities and inferior seeds should be removed by passing the seed through a tobacco seed separator. Practical and experimental results have definitely proved that tobacco produced from heavy, well-developed seed is more uniform in size and colour, and produces larger yields than crops grown from ungraded seed.

It is not expected that every grower will provide himself with the necessary apparatus for this work. Each grower can, however, send his tobacco seed to the Agricultural Department, where it will be cleaned and treated at a small charge. Parcels of cleaned or treated seed are returned carriage free to the growers. For those who prefer to treat their own seed, the following is the method used: Dissolve 17½ grains silver nitrate crystals in two pints clean, cold water. Soak the seed in this solution for fifteen minutes. Strain through a fine muslin bag and wash thoroughly in frequent changes of clean water until seed is free from traces of silver nitrate solution. The seed may then be sown wet or be dried for sowing later. When drying, the seed should

be thinly spread on a sheet of material or paper plaçed in the shade and not in the sunlight. In place of silver nitrate, mercuric chloride or corrosive sublimate may be used at a strength of 1 in 1,000.

A more recent method in use by the Department of Agriculture in the Union of South Africa is to treat tobacco with a dry powder, "Ceresan," used in the proportion of one part Ceresan to twenty parts of tobacco seed by weight. The seed must be kept dry until it is sown.

When using only properly graded seed, the following are the quantities to be used:—

1 oz. of seed is sufficient to sow 120 square yards.

12 ordinary teaspoons (level full) will sow 120 square yards.

1 ordinary teaspoon (level full) will sow 10 square yards of seed-bed.

Lighter applications of seed than at the above-mentioned rate of seeding are capable of yielding satisfactory results, but can only be recommended in the case of experienced tobacco growers having suitable facilities and using thoroughly reliable seed. Under favourable circumstances the rate of seeding may be reduced by from one half to two thirds, *i.e.*, one ounce of seed per 240 to 360 square yards instead of an ounce of seed to 120 yards of seed-bed area.

In order to distribute evenly such a small quantity of seed over the given area, some substance must be used as a distributing medium. It has been found from practical experience that wood ash and mealie meal—preferably wood ash—are the most satisfactory materials to use. Both are white in colour and indicate plainly the distribution of the seed within the medium itself, besides the distribution over the surface of the seed-bed. The proportion of seed to wood ash or mealie meal is one teaspoon of tobacco seed to about a quart of ash or meal. The seed should be thoroughly mixed with the distributing medium before sowing. Some growers prefer to put the requisite quantity of tobacco seed into a can of water and, after thorough stirring, apply the mixture of seed and water to the beds. Whatever method is followed,

the beds should be thoroughly watered on the day previous to seeding, as this will reduce the quantity of water required immediately after the beds have been sown and thus reduce the risk of the seed washing.

When sowing the beds, care should be taken to distribute the seed evenly over the whole surface of the seed-bed. Sowing is best done when the air is calm. Should it be necessary to sow seed-beds when a wind is blowing, much wastage of seed is prevented and more even seeding made possible by holding up a reed mat or similar contrivance on the windward side of the bed. This improvised windbreak can be moved along so as to enable the person sowing the seed to do so within the shelter so provided.

After sowing, a light dressing of clean sand should be applied. This serves not only to prevent washing, but the sharp grains of sand act also as a deterrent to the small ants which carry away the germinating tobacco seed. This must be carefully done or the seed will be covered too deeply. Immediately after this the beds must be watered with watering can fitted with a finely perforated rose.

In the early stages of growth, especially, the plants require to be kept moist, but not too wet. Usually the newly sown beds are watered in the mornings only, and later on, when the seedlings are bigger, beds are watered morning and evening, while at a further stage in the growth of the plants, an additional watering at mid-day may be required. Owing to varying conditions, it is impossible to state how many times a day watering is necessary or the rate of application. A good rule to follow is to have the seed-beds always moist but not too wet. Before applying water to the beds, the coverings should be removed and replaced afterwards. Watering must be done with cans or garden hose; irrigation and flooding are not advisable.

Water near the banks of a river, stream or pool is often infested with nematode. As a precautionary measure, therefore, water for the seed-beds should be taken from mid-stream, preferably by means of a pump. Where cans or buckets are used, a reasonably wide and strong platform should be built out into the middle of the river or pool. Wet utensils should

not come in contact with the soil at or near the water's edge, as soil particles adhering to the bottom of such utensils may carry nematode to the seed-beds.

All seed-beds should not be sown on the same date, but should be seeded in batches at intervals of about fourteen days.

For Virginia type tobacco sufficient seed-beds should be sown at one time to provide transplants for at least twenty acres, so that a sufficient area can be planted at one time to furnish enough ripe, uniform leaf for the first curings. When this practice is followed, the several operations of cultivation and curing can be carried on in succession, and labour can be used to better advantage.

The area of seed-beds required depends upon the extent of the intended acreage and the type of tobacco grown. For Virginia type tobacco about twenty square yards will provide sufficient plants for one acre. For Turkish type tobacco about 100 square yards are required for each acre to be grown.

Covering.- In the early stages of growth tobacco plants are very tender and delicate. Extreme cold at night and hot sun during the day are both injurious; some covering is therefore essential to protect the young seedlings from the extremes of heat and cold. Either grass or cheese-cloth is used for this purpose. Growers are, however, advised to use cheese-cloth in preference to grass, as the latter is difficult to manipulate in order to give the seedlings the proper amount of sunlight.

If the grass covering is too thick, the plants are inclined to become lanky and weak. If too thin, the young seedlings are often killed through the surface soil becoming too dry. Grass coverings also often harbour the moths of the tobacco split-worm and stalk borer, both of which pests cause severe damage to the young plants. On the other hand, cheese-cloth protects the plants from the direct rays of the sun and at the same time allows sufficient light for proper growth. If the beds are properly enclosed, cheese-cloth will keep the beds warm at night by retarding radiation, which hastens the growth of the seedlings and will also protect the plants from insect pests. After use the cheese-cloth coverings should be washed and thoroughly sterilised by boiling in water for about

thirty minutes. The cloth should then be properly dried and rolled up for storage until next required. With reasonable care cheese-cloth will last for a number of successive seasons.

The cheese-cloth is fastened to the wire stretched down the centre of the bed so that one half of the width of the cloth is on either side of the seed-bed. The edges of the covering are then pulled over the sides and ends of the bed and held in place by weights placed at intervals on top of the sides of the seed-bed. When it is necessary to uncover the beds, these weights (generally stones or bricks) are removed and the covering rolled back until the centre wire is reached. A double thickness of cheese-cloth should be used on the beds during the first fortnight after sowing, in order to assist germination and protect seedlings from the hot sun. The extra cover is then removed, leaving only one thickness to cover the bed.

Care of Seed-beds.—Constant care must be given the seed-beds if satisfactory results are to be obtained. If neglected for a few days, the seedlings may suffer a set-back or even die off through lack of moisture or be destroyed by insect pests or disease.

During the germination period and the early stages of growth, watering cans should be fitted with a finely perforated rose so that the seed may not be displaced or the soil washed away from the small seedlings. When the plants have leaves about the size of a shilling coin a more coarsely perforated rose should be used on the cans. After the plants are larger and firmly rooted in the soil, the use of a rose may be dispensed with. For watering plants in this stage a small square of tin may be clipped to the water can spout and bent up in such fashion as to cause the water to fall on the beds in a broad, flat spray.

At first the cheese-cloth must remain over the beds the whole time except for the short period the beds must be exposed for watering. When the plants have grown a little, the covering is left off for a short period each morning to allow them more sunlight and prevent weak stems. The period of exposure is gradually lengthened as the seedlings grow, so that by the time they are the correct size for trans-

planting, the covers are left off all day and only replaced at night. This procedure will harden the plants and enable them to stand being transplanted.

After the seedlings are large enough for transplanting (roughly six inches high), they should receive only sufficient water to prevent excessive wilting. Should weeds or grass appear at any time, they should be removed from the seed-beds.

Before removing seedlings for transplanting, the seed-bed should be well watered so that the plants can be easily removed without injury to themselves or the remaining plants. After all suitable plants have been removed, the seed-bed should be again watered to firm the soil around the roots of the remaining seedlings in order that their growth may be retarded as little as possible.

The plants in the seed-beds may sometimes fail to make satisfactory growth; this may be due to insect pests, diseases or unfavourable soil conditions. If the soil is water-logged through the application of too much water, the amount should be reduced and the soil lightly stirred. If due to insufficient drainage, proper drainage should be immediately provided. Excessive alkalinity of the soil will also adversely affect the growth of seedlings, and where this is suspected as the cause of retarded growth or dying off of seedlings, suitably selected samples of the seed-bed soil and the water used for watering the beds should be sent to the Agricultural Laboratory for analysis and remedial recommendations by the Chemistry Branch. Overcrowded beds do not allow the plants to make satisfactory growth; when this occurs thinning out is necessary.

Should insect pests or plant diseases be troublesome, the grower is advised to seek the advice of the Entomological and Plant Pathology Branches, Department of Agriculture.

In the case of the lack of plant food, the plants will usually have a sickly yellow appearance. This is especially noticeable when there is a deficiency of nitrogen. Nitrogen may be supplied by means of a solution of nitrate of soda or liquid fowl manure. The latter is to be preferred, as it is cheaper and more easily procured, besides also furnishing a

more complete plant food than the nitrate of soda. The nitrate of soda solution is:—

1 lb. nitrate of soda.

8 gallons of water.

The above quantity is sufficient for about twenty square yards of seed-bed.

The liquid fowl manure is prepared in the following manner:—Take a suitable receptacle and half fill it with fowl manure. To this add sufficient water to fill the receptacle. The receptacle should be allowed to stand for about five or six days, and its contents frequently stirred at regular intervals. After standing for this period the liquid manure is ready for use. One gallon of liquid fowl manure is diluted in eight gallons of water. This should be applied to ten square yards. After a few days a second application may be given.

The usual tobacco fertiliser mixtures can be used for stimulating the growth of backward plants, and is applied broadcast over the beds at the rate of one pound per ten square yards.

None of the above should be applied to young seedlings with leaves smaller than a threepenny coin, as the small plants would be damaged by the solution or fertilisers.

Immediately after the application of liquid manure, fertiliser solution or mixtures, the beds should be watered to wash the plants to prevent the leaves from being burned. When possible, application should be made on a dull, cloudy day or late in the afternoon, so as to reduce the danger of the leaves being scorched.

Summary.—

1. Use discretion in the selection of the seed-bed area and pick the best site.

2. Make sure that the site is close to a permanent, uncontaminated and adequate supply of water.

3. Provide suitable drainage for seed-beds, and erect suitable shelters where necessary.

4. Make the beds and pathways a convenient width, and prepare the seed-beds thoroughly before seeding; they cannot be prepared afterwards.

5. Sterilise the soil in the beds.

6. If possible, use a fresh site each season, and use the same ground but once in every four or five years.

7. Use good seed, which is properly cleaned, graded and treated.

8. Use the correct quantity of seed in sowing; thickly seeded beds usually mean poor plants.

9. Sow the beds at proper intervals, to give a good succession of suitable plants for transplanting.

10. Water the beds so that they are kept moist, but not wet.

11. Spray regularly with suitable fungicide to protect the seedlings from disease, and handle the plants as little as possible.

12. Keep the immediate surroundings of the seed-beds clear of all undergrowth and trash; this helps to control insect pests and reduces the fire hazard.

13. Use only fertiliser of good quality and properly made compost for application to seed-beds.

14. Have plants the correct size for transplanting (about six inches) long, lanky plants and under-sized plants are not likely to give the best results.

15. Always soak the beds before removing seedlings for transplanting and water again immediately afterwards.

16. When transplanting is completed do not leave plants growing in the seed-beds, but remove the plants for burning and dig over the beds.

17. When cheese-cloth is no longer required for covering the seed-beds, remove it, and after being washed, sterilised and dried, roll it up and store safely until required for use next season.

18. Make every effort to produce good, strong, healthy seedlings; good crops are seldom grown from inferior plants.

The Artificial Incubation, Brooding and Rearing of Chickens.

By H. G. WHEELDON, Poultry Officer.

Everyone engaged in poultry farming is confronted with the problem of raising young stock. The pivot point on which the success of the poultry farmer turns is his ability to renew the laying flock satisfactorily each year. The profitable period of a fowl's life is so short that it is necessary to raise stock for the laying pens every year, and the beginner finds this to be the most difficult part of the whole business, while success in this direction is most important. It is attained only by the intelligent application of correct methods. If the incubation, brooding and rearing of chickens are not carried out under such conditions as will produce and maintain both growth and good constitutional qualities the mature stock will fail to produce or earn more than a nominal profit. A set-back during the life of the chicks may adversely affect their stamina, and the progeny of such stock, if raised under similar conditions, will be less valuable than the parents. With such deterioration the flock would become unprofitable in two or three generations. On the other hand chicks from good stock, if given intelligent care and surrounded with the essentials required for proper growth and robust development, would mature into poultry capable of returning to their owner the last farthing in payment for the food and accommodation provided. Good methods and well grown mature stock increase the productive efficiency of succeeding generations and successful poultry farming is appreciably maintained.

The chick hatched for the market must make rapid gains. To do this in the shortest time assures the greatest profit, and the conditions and methods of rearing in some respects are artificial. The chick destined for the laying house, however, must be allowed to grow steadily without any set-

back and more natural conditions might be approximated with a view to raising stock robust in constitution. The young birds will then withstand the strain of consistent egg production, which is necessary to produce the results that count.

The building up of a strain of fowls involves something more important than the selection of standard requirements or prolific egg production, namely, breeding for health and constitutional fitness. Those who are successful in the business on a large scale have learned by experience that it pays to select only healthy vigorous stock for breeding. Unless inherent these qualities are less likely to be transmitted to the chicks, whereas constitutional defects may be reflected in several generations, with a tendency to increase rather than lessen in a given strain. The breeding stock should be sound in health and not too closely inbred.

The Breeding Stock.—Select the breeding stock for health and constitutional qualities, then for desired qualities in other respects. Choose only the best for the breeding pens, even if a few birds only are used, and pen them with a view to off-setting minor physical defects by mating birds that are strong where the others show weakness. When the individual birds have been selected and penned according to ancestry, then house, manage and feed them with a view to maintaining health and profitable returns. Their requirements must be met and regular supervision is necessary. A comfortable shelter when needed from the rays of the sun and during wet weather; a fair variety of wholesome food; clean drinking water; always *a liberal supply of green food*, and suitably ventilated houses without draughts are the important essentials.

It is not sufficient to exercise reasonable care with the breeding stock alone, the careful handling of the eggs before incubation, during incubation and the management of the chicks to maturity are of equal importance. It is upon the common sense application of their requirements that the success of commercial poultry production depends. Lack of stamina is often the result of in-breeding, overcrowded quarters and unsuitable rations which undermine the constitution of chickens.

Assuming then that the breeding birds have been carefully selected, well housed and supplied with their normal requirements, the next point of importance is the proper care of the eggs for incubation; this is where many poultry farmers unconsciously go wrong. Careless methods of handling and storage of the eggs for incubation and during incubation impairs the hatchability. Probably more chicks are found dead in shell or are weakly after hatching as the result of wrong methods of handling them than from any other cause.

Eggs for Hatching.—Eggs intended for the incubator should be gathered once daily in cool weather and twice during the hot weather. Renew the nesting material often, handle the eggs with clean hands, place them in a clean receptacle, and keep them in a rack with small end downward, or if they are stored on their side, turn the eggs daily. Avoid excessive evaporation of the contents of the eggs by covering them with a cloth. The room in which they are kept should be fresh and cool, a temperature of about 60° F. is desirable Wherever possible they should be used for incubation before they are ten days old, as the germ weakens with age. Prolonged exposure of the eggs to a temperature of 80° or 90°, or frequent warming and cooling before incubation, may destroy the germ or will surely result in a weak chick. Select only the best eggs for incubation. Uniformity in size, shape and shell texture are important and they should not be less than 2 oz. or above 2¼ ozs. in weight.

Artificial Incubation.—Artificial incubation may account for considerable losses, because the hatchability of eggs is so easily affected by machines carelessly operated or handled without sufficient knowledge of the work. It should be mentioned that with the modern systems of incubation good results are invariably obtained if the machines are managed with due care. There are various types and makes of incubators, such as moisture or tank machines and those embodying the hot air principle, each of which gives satisfactory results. Mammoth coal burning machines are available, and cabinet incubators embodying similar principles more recently introduced are heated either by blue flame or electricity. It is necessary to understand thoroughly the operation and conditions most suitable for these incubators by following the printed instructions accompanying each machine.

In choosing an incubator be sure of obtaining one of sufficient capacity to meet requirements. It is much better during the initial stages to incubate fewer eggs in a machine with reasonable greater capacity than to have a surplus of good eggs for hatching with only a limited incubation capacity. There are disadvantages also in extending the incubation season over a period of several months for the renewal of the laying flock. Adequate incubator capacity would ensure a given number of chicks over a shorter period.

Incubation may be successfully carried out throughout the year, especially when ducklings and chickens are intended for table purposes. The most seasonable and profitable period for hatching chicks of the heavy and light breeds for the laying flock is during May to August.

The most important points to consider in providing suitable conditions for incubation are uniform temperature, adequate moisture and ventilation in the room and freedom from excessive vibration. It is important that the incubator be level on a solid foundation or platform and the room suitably ventilated and controlled to provide a steady replacement of the atmosphere without excessive draughts. Strong currents of air may be controlled in windy weather by inserting hessian covered frames in the open spaces provided for ventilation. The small type of incubator should be placed about one foot from the walls of the room.

After studying the instructions carefully and having set up the incubator under proper conditions, it should be operated without eggs for a few days, to become thoroughly acquainted with the details and for adjustments to the regulating device. An even temperature of 102° to 103° in the egg chamber is required during the early stages of incubation. The thermometers should be tested annually to make sure they are in order before incubation commences. The chief requirements in successful incubation are uniformity of temperature with adequate moisture and ventilation. It is advisable to fumigate the egg chamber with formalin after each hatch.

The possibility of disease during incubation can be minimised by fumigation of the egg chambers which is a

desirable precaution also in the case of purchasing second-hand machines. For fumigation the ventilators should be plugged or strips of paper pasted over them, wet the interior of the compartments with water and then insert a saucer or shallow tin containing permanganate of potash crystals with double the amount of commercial formalin poured over the crystals; 1 oz. formaline to ½ oz. permanganate of potash would be sufficient for every five cubic feet internal measurements, close the machine and maintain its operating temperature for a few hours. After fumigation leave the machine open to air before placing in the eggs.

Having fumigated and thoroughly mastered the operation of the machine and maintained a uniform temperature in the empty incubator, fill the trays. The eggs should be left for several hours to warm up when the temperature will automatically rise to about 103° After 24 hours the eggs should be turned and aired, and this should be done at regular intervals throughout the period of incubation.

There are no infallible rules for operating an incubator. The amount of moisture and ventilation required, the manner of turning and cooling the eggs and other details cannot be definitely stated for all machines. These are subject to variation according to the type of incubator and climatic conditions. The mammoth machines and some of the smaller incubators are equipped with a turning device and printed instructions for their operation accompany each machine. The usual method of turning eggs by hand in small incubators is to remove the eggs in the centre of the tray to the side or end of the rows, and gently roll those at the side to the centre of the tray. This method may be adopted for turning and cooling the eggs in the morning, but in the evening give each egg a quarter or half turn, then close the drawer without cooling them. As to the length of time the eggs might be left to cool, no hard and fast rule can be given, this must be left to the discretion of the operator. In hot weather, however, when the temperature of the incubator and the room tends to rise, the eggs may be cooled from five to fifteen minutes longer than under ordinary conditions, remembering always that during the last week of incubation eggs also require more air than they do during the first ten days.

Under ordinary conditions the eggs are aired and cooled during the early stages of incubation sufficiently to give best results while they are being turned. A point of great importance is to turn the flame of the lamp very low during the time the eggs are being cooled. The embryo chick generates animal heat as soon as it commences to develop and the volume of warmth increases steadily during the period of incubation. This is the reason why the temperature usually rises during the last week or ten days, and it may be necessary to reduce the flame of the lamp very considerably or to readjust very carefully the regulator during this period. It is inadvisable to tamper with the regulating device during the hatch, but it must be done if after lowering the flame the temperature tends to rise above 105° F.

The normal periods of incubation are as follows:—Fowls, 21 days; domestic ducks, 28 days; muscovy, 35 days; geese, 28 days; turkeys, 30 days; guinea fowl, 26 days; English pheasant, 26 days.

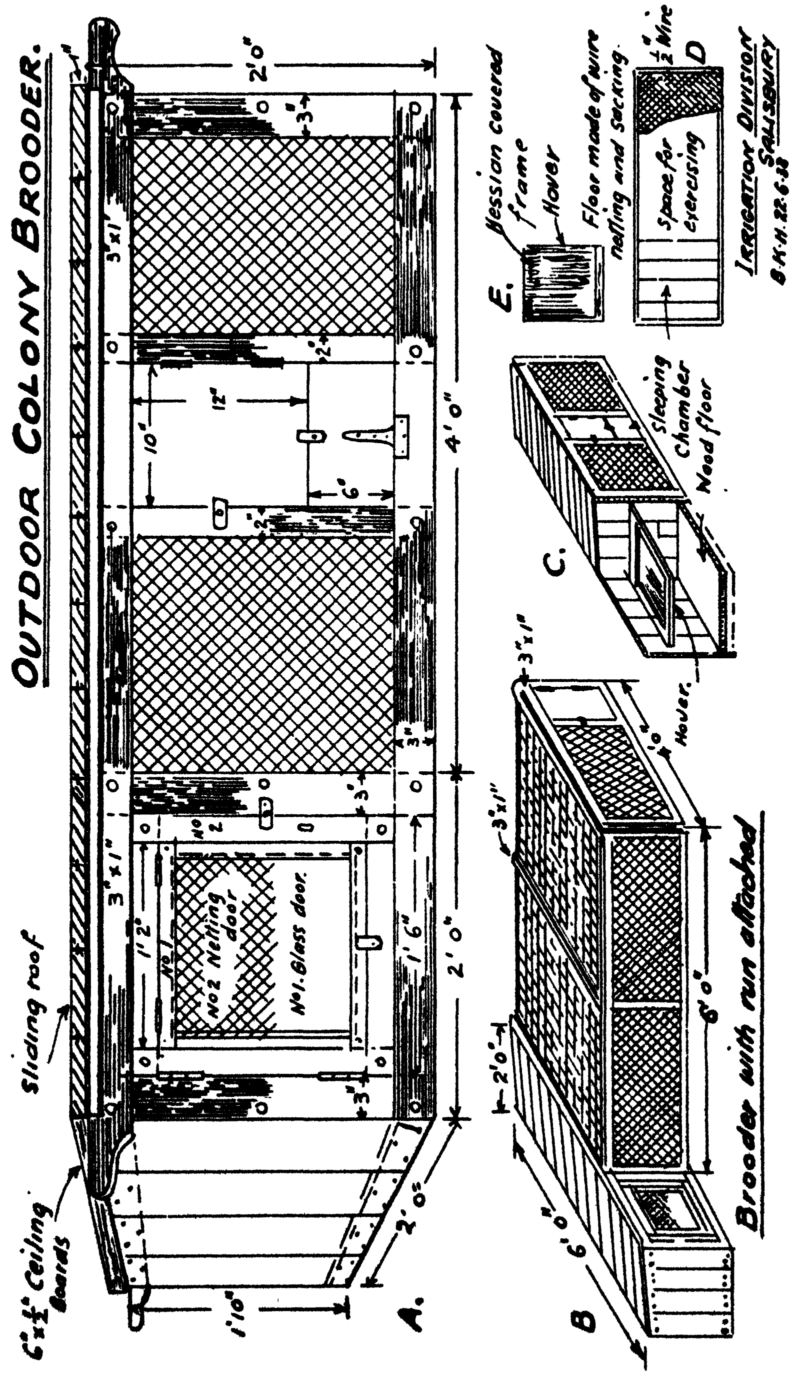
The eggs may be tested twice during the period of incubation, the first test on the seventh day and the second on the fourteenth day. At the first test remove all infertile eggs, broken yolks and dead germs. Mark those which may be doubtful and continue to incubate them until the second test. If they do not develop further by that time they should be removed, as well as all other dead and weak germs and addled eggs. Turning of the eggs should be discontinued on the morning of the twentieth day or sooner if the chicks begin to hatch. On the morning of the twenty-first day gently remove empty shells and place the hatched chicks in the drying box, or as provided in some machines in the nursery trays, and allow them to dry off for twenty-four to thirty-six hours, when the chicks should be removed to the brooders. The brooders should be thoroughly cleaned and littered with grass. Fireless or cold brooders should be placed with the chicks in a sheltered sunny locality, taking care to provide shade when required. From this stage until a few days old the chicks will require frequent attention, and it is important to avoid excessive exposure during the early morning and evening to avoid chilling. The activities of the chicks will indicate plainer than words whether they are comfortable or

not. If crowding together and chirping, their usual requirement is warmth. Close observation and careful management will ensure good growth to marketable age or maturity of a large percentage of the chicks placed in the brooders after hatching.

Artificial Brooding.—Artificial brooding is comparatively simple when the requirements are thoroughly understood. Although constant attention and observation are necessary, any system other than artificial brooding in the case of chicks hatched and raised on a commercial basis would be too laborious and out of the question. The main object is to provide facilities for protection and to keep the chicks warm and comfortable during the early stages after hatching. They should be kept under control and provided with conditions to encourage good health and robust development. The care and attention given to chicks during the first few days, the critical period of their life, determines to a great extent their future value. The most satisfactory and economical types of brooders are generally those that are portable.

There are two types of artificial brooders, both of which have proved satisfactory and adaptable to the requirements of the poultry farmer for brooding chicks in either small or large units. They are the fireless or cold brooder (a misnomer) and heated brooders; the greatest essentials being efficiency, convenience, economy and safety.

Fireless Brooders.—The drawback with most brooding systems is the cost. The need of an efficient, convenient and economical means of brooding chicks in small units is a matter of importance to many poultry keepers, and for this purpose the fireless or cold brooder, such as is shown in the accompanying design, is advocated. The outdoor colony brooder is easy to construct and handle. It affords the necessary protection from vermin and can be moved to fresh ground as often as may be necessary. The capacity of this brooder provides for 50 chicks without artificial heating. This system has been practised for a considerable number of years with satisfactory results in this Colony. Heated brooders are not necessary for brooding chicks in small units in warm localities. Suitable arrangements could be made to equip this brooder with a temporary heating device in the case of emergency when the


OUTDOOR COLONY BROODER.
Sliding roof
6"x½" Ceiling Boards
No 2 Netting door
No 1 Glass door.
A.
B
Brooder with run attached
Hover.
C.
Sleeping Chamber
Wood floor
E.
Hessian covered frame
Hover
Floor made of wire netting and sacking
Space for exercising
½" Wire
D
IRRIGATION DIVISION
SALISBURY

chicks are to be removed from the incubator during a spell of cold cloudy weather. This requires careful attention, however, to avoid overheating the chicks and heating devices are not generally necessary.

The brooder must be thoroughly clean and the floor littered with grass or straw. The interior of the brooder chamber should be thickly lined with long grass on all sides to provide a fairly deep nest in which to brood the newly hatched chicks on removal from the incubators and at night. The hessian covered frame or hover is placed over the nest and pressed down to about one or two inches above the chicks in the nest. As the chicks require more room and ventilation so the nesting material should be reduced until only sufficient grass is left to round off the corners and support for the hover. The hover can be raised in this way as the chicks increase in size and finally removed when they are reasonably well feathered. This hardens them off before their transfer from the brooder at five to six weeks of age.

The chicks should be confined to the hover section most of the time during the first day or two, especially if the weather is unfavourable, the position of the brooder should be adjusted periodically so as to admit the sun to the interior of the brooder all day if possible. From the third day they can be confined to the exercising apartment to a greater extent with access to the brood chamber as they require it and later allowed in the attached wire run. During the first two or three days when the chickens are confined to the hover section it must be lifted several times a day at regular intervals for feeding the chicks, but the chicks must be replaced under the hover after feeding before they become chilled. By frequent handling in this manner the chicks soon learn what is required of them, and may soon be trusted to take care of themselves when they require warmth. If they show any disposition to crowd or huddle together outside the brooder chamber at any time, place them under the hover to warm up. When they are a week old they may be allowed access to the wire run. A covering on top of the run is necessary for shade in the absence of shade from trees. Not more than fifty chicks should be placed in this type of brooder, as it is considered the maximum limit of safety. Care must be taken

to keep the chicks warm and comfortable at all times, and to provide ample ventilation for them at night. Overcrowding under the hover with insufficient ventilation, especially at night, will definitely impair the vitality of the chicks and will lead to respiratory troubles, stunted growth and mortality. Overcrowding is as harmful as supplying unsatisfactory rations.

The chicks should be given the opportunity of exercising in quarters that are not too cramped. They should be provided with sufficient hopper space to allow easy access to the food and water at all times during the day. Sun and air the hover compartment daily when not in use, as well as the litter. The litter should be renewed as often as may be necessary, generally twice a week.

Heated Brooders.—Of the many types of heated brooders the oil burning, electrically heated and battery systems are probably the most commonly used, and to a less extent the hot water pipe system. There is also the flue system and coal burning brooder stoves for heating the entire apartment for brooding chicks. All these methods of providing warmth are giving satisfactory results. Heated brooders and apartments must be suitably ventilated.

They are as a rule centrally heated and in the case of brooder stoves the heat generated is greater than the chicks require. The room must be large enough to provide sufficient floor space to allow the chicks to regulate for themselves the distance from the heater or degree of warmth they require. The room should not be allowed to become stuffy and oppressive during the day through lack of ventilation. Such brooder apartments should be provided with facilities for ample ventilation during the day and to a less extent at night. The zones of heat varying in temperature on the floor level at night enable the chicks to choose the temperature most comfortable to them by spreading out on the floor of the room. The room temperature for battery brooders on a large scale may be automatically regulated and controlled.

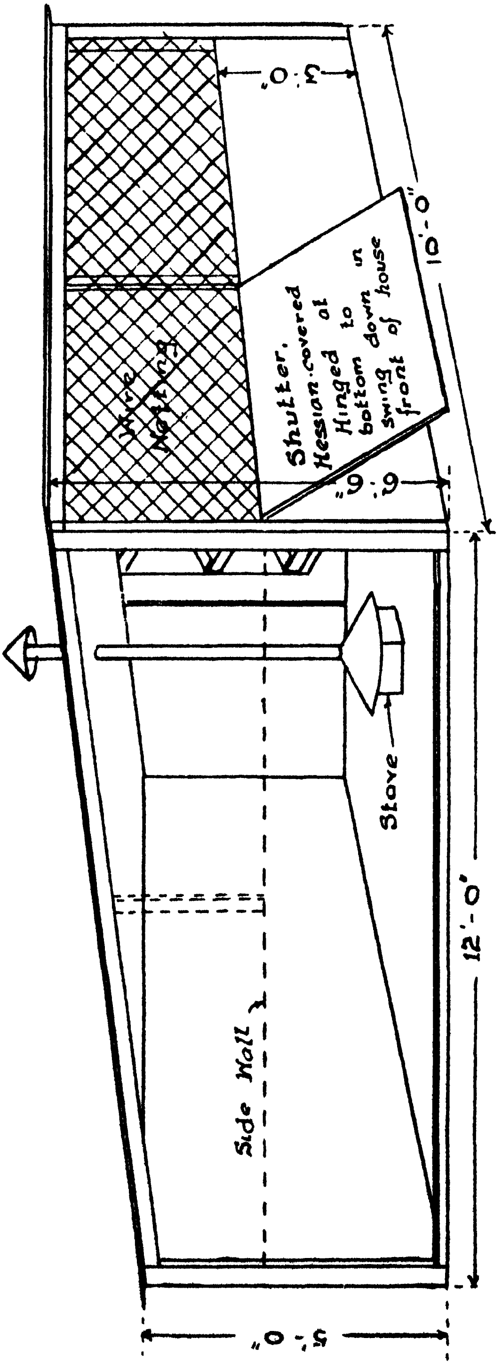
The oil burning, electrically heated and hot water systems are generally adaptable to the hover or box and canopy design of brooder. They provide a minimum heating

capacity to keep newly hatched chicks warm and comfortable and are more practicable and economical for brooding chicks in units of moderate size. They meet, with practically no exception, all the requirements laid down for satisfactory brooding and may be placed in any convenient building or in a brooder house designed and equipped for that purpose. Where brooding is undertaken on a large scale with heated brooders a special brooder house is necessary, which must be designed to fulfil the requirements of the heating system to be adopted.

Brooder House.—There are three types of brooder houses generally used for the successful rearing of chickens. They are:—

1. The portable or colony house.
2. A long permanent building sub-divided into pens having either a built in or portable heating system.
3. Permanently built house for brooder stoves.

1. Colony brooder houses installed with a portable heating system should be made as large as can be moved conveniently. A house 10 ft. by 12 ft. should be the minimum for units of 300 chicks. A suitable size for units up to 500 chicks would be 14 ft. by 16 ft. A lean-to roof at least 6 ft. 6 in. in front and 5 ft. at the back should suit a house 12 ft. deep, and an uneven span or apex type of roof would be more satisfactory for a house which is 16 ft. deep, the height of the walls being 6 ft. and the roof at the apex 7 ft. 6 in. The accompanying design (Fig. 2) illustrates a brooder house which is considered satisfactory for this purpose. It can be moved conveniently on most farms. The house consists of a wooden frame with water-tight roof. The sides, back and front should be covered with wire netting, attached to the inside of the framework. The back wall and lower part of the sides and front should consist of some light weather proof material, such as galvanised sheet iron, malthoid or rubberoid, etc. This should be 3 ft. high on the sides and front wall. The openings above this may be fitted with hinged wooden frames covered with fine hessian, hinged at the bottom to swing down on the outside of the



PORTABLE BROODER HOUSE, WITH BROODER STOVE

[Side of House Removed.]

house. These shutters may be closed for protection when necessary or opened for ventilation and to admit sunshine as may be required.

2. A brooder house constructed of bricks for built-in or portable heating systems should be 12 ft. deep with a passage 3 ft. wide along the interior of the back wall. The house should be sub-divided by wire netting partitions 6 ft. apart for units of 100 young chicks and sub-divided into larger sections when the brooding of larger chicks is intended. A northern aspect is preferable. Outdoor wire runs should be provided to coincide with the internal sub-divisions of the house. An open fronted house of this type can be operated successfully in some localities, but provision should be made to minimise ground draughts by solid dwarf partitions 12 inches high and with hinged cloth covered frames for closing the open front when desirable in cold weather. In cold climates the front of the house should be enclosed with glass windows to afford the protection necessary. In planning a brooder house, consideration must be given to convenience in attending to the chicks, inspecting the hovers, feeding and watering, disinfecting and cleaning.

3. For brooding chicks in large individual units proper facilities are required which entail the provision of equipment most suitable for this purpose. The types available would be heated battery brooders, and the canopy type of brooder stoves, or a combination of battery brooder with other systems deserve consideration. Battery brooders are compact and may be housed in almost any convenient room. A room suitable for a canopy coal burning stove with a capacity for 1,200 chicks would be 25 or 30 ft. long and 15 or 18 ft. deep respectively suitably enclosed in front. Runs at the back and front of the house should be provided for alternate use and with four exits or trapdoors in the walls to each run.

A system of battery brooding for large numbers of chicks immediately after hatching combined with other heated systems such as may be in existence, to be used for the chickens as they become stronger, would be of considerable advantage. Battery brooders electrically heated are reliable, economical in fuel and easy to operate. They are extremely useful during the early stages up to three weeks of age from

hatching. They facilitate the safe handling of chickens in large numbers during their early life when the conditions required by them are definitely more exacting. As the chicks become stronger they are better able to fend for themselves and withstand the conditions on being transferred to the brooder houses such as those equipped with other heating devices in which the sub-division of chicks in smaller units is practised.

Ventilation and Temperatures.—The importance of adequate ventilation in the brooder house and brooders cannot be too strongly emphasised. Adequate ventilation of the brooder house itself does not necessarily ensure sufficient ventilation under the hovers, these must be provided with facilities to permit a free circulation of air.

With heated brooders the temperature is another important factor. Insufficient warmth induces crowding and is harmful; over-heating, due to lack of ventilation, causes sweating, resulting in respiratory troubles, which impair the vitality of the stock. These conditions are particularly observed under hovers equipped with strips of cloth or curtains that hang close to the floor and which restrict the circulation of air. When used the ends of the cloth should be at least 2 inches from the floor. In operating such brooders additional ventilation and a reduction in the temperature as the chicks grow older must not be overlooked. At the start the temperature in the brooders should be 90° to 95°, and this should be gradually reduced to 65° at the end of the second week. Later the chicks should be brooded without artificial heat for a time before transferring them to outside quarters.

Brooder Management.—The brooder should be ready for the chicks at least two or three days before the chicks arrive. If it is a new brooder with regulating device make sure it is properly adjusted and that it works freely. The capacity of the brooder should not be exceeded. When too many chicks are brooded together proper control of the young stock and access to the food hoppers is not always possible. Do not attempt to brood chicks of different ages in the same flock under the same hover. The brooder house floor should be lightly covered with coarse clean sand for large heated

brooders and only a section of the floor of the room partitioned off with boarding in which to place scratching litter such as chaff or cut grass to a depth of 2 inches.

With heated brooders the liberty of the chicks should be at first restricted confining them within a reasonable radius from the hover by a temporary wire netting screen for the first few days. Advantage should be taken during this period to train the chicks to return independently to the hover for the warmth and protection they require. They will soon learn to take cover, and as they become older and more independent they should be given more room to exercise, and after the end of the first week the whole of the floor space should be accessible to them. At this stage the chicks may be allowed out into the outside runs of the brooder house during fine weather. Observation is necessary on the first occasion, as they may not be able to find their way back into the brooder house. Sanitation and cleanliness under the hovers and in the brooder house are very essential for health and the sturdy development of young stock. The brooder compartments should be thoroughly cleaned and disinfected after the removal of chickens.

Chickens at 5-6 weeks old are generally well feathered and they should be removed either to outside coops confined in pens, or reared under the colony system. On transferring them to their new quarters they will require some attention for several evenings to accustom them to their new surroundings. This attention would be amply repaid and is necessary to obviate overcrowding and possibly mortality. They should be accommodated in units of 50 or a maximum of 100 chicks and separated according to sex. Perches are not necessary at this stage, but the floor of the house should be well littered and the corners rounded off with grass, or preferably with wire netting, to prevent corner crowding. As the chickens develop the accommodation should be increased or the number of chicks reduced according to the size of coops in which they are accommodated.

Feeding.—The proper feeding and management of the young stock determines to a great extent their future value as breeders and layers.

Growing birds want variety, if for no other reason than to maintain their appetite, and there must be no stinting of food, although waste must be avoided. There is an axiom in the management of stock that the "feeding must be above the breeding" if improvement is to be obtained. While it is true that improved results would be secured by sound methods of feeding, it is equally true that still better results would be obtained by having the stock properly bred and properly fed. In this way the greatest return would be derived from a given amount of food.

The object of the poultry breeder to-day is to economise in almost every branch of his business, but there is one place where stinting is false economy, and that is in the supply of food. It is much better to hatch fewer birds and feed them well within one's means than to try and raise a large number that may be under-nourished.

The successful feeding of chicks is not a difficult problem provided they are supplied with their natural requirements. Almost any wholesome nitrogenous ration made up of grain and grain by-products, green food and animal food given regularly is what they require in the way of food and they must always have access to clean water and grit.

The chicks will be ready for their first food 36 to 48 hours after hatching. It is necessary to bear in mind that the newly hatched chick, by absorption of the yolk of the egg just prior to emerging from the shell, has been provided by nature with sustenance for the first 48 hours after hatching. Feeding, therefore, too soon after hatching, is not only unnecessary but undesirable and may prove harmful.

The food should be given preferably when they have been removed from the incubator to the brooder. They should be provided with shallow vessels each containing dry mash, water and a little grit. Two or three pieces of straw may be allowed to float on the surface of the water, which the chicks will peck at, and soon learn to drink. At frequent intervals during the first two days their attention should be drawn to the food, either by tapping the food with the forefinger or by taking a pinch of the mash between the fingers and allowing it to sift down from a few inches above the food tray. By these

simple means chicks can be taught to eat and will soon learn to care for themselves. A small quantity of pinhead oatmeal may be given twice a day as an additional feed during the morning and evening. From the third day a little munga or commercial chick food may be given in conjunction with the dry mash, substituting the oatmeal and feed at frequent and regular intervals during the course of the day.

The best results are obtained by the dry mash system of feeding, either combined with grain or fed as an "all-mash" ration without the use of grain. An all-mash ration simplifies feeding and the stock make greater gains in weight as a rule; when it is desired to feed grain with dry mash it can be done by substituting grain for portion of maize meal.

When the feeding of moist food is adopted, the mash should be mixed to a crumbly consistency with separated milk or warm water, and the chicks given only sufficient to be consumed in half an hour. The food left over after that time should be removed until the next feed. Moist mash may be fed in conjunction with dry mash as a regular system in the rearing of table birds. For stock that are intended for the laying and breeding pens, however, the mash in a moist state should be regarded as supplementary, especially for late hatched chicks and chicks that have gone off their feed or flagging. A moist mash as a change stimulates the appetite and encourages a greater consumption of food and maintains good growth and development. Grit and water are necessary at all times, and finely cut tender green vegetation must be given daily. Bone meal, lime and salt as a mineral mixture may be incorporated in the mash for all ages of growing stock. Separated milk, when available, is a desirable addition given either mixed with mash as a moist food or the curd given in separate receptacles. It is better to give the curd after draining off the whey when milk is supplied separately.

The grain mixture or munga should be fed in loose litter, which will induce the chicks to exercise by scratching for it. Feed the grain four times a day in small quantities at regular intervals for young chicks. As the chicks grow older accustom them to a larger range or run, placed with the brooder on grass covered ground. The site which has

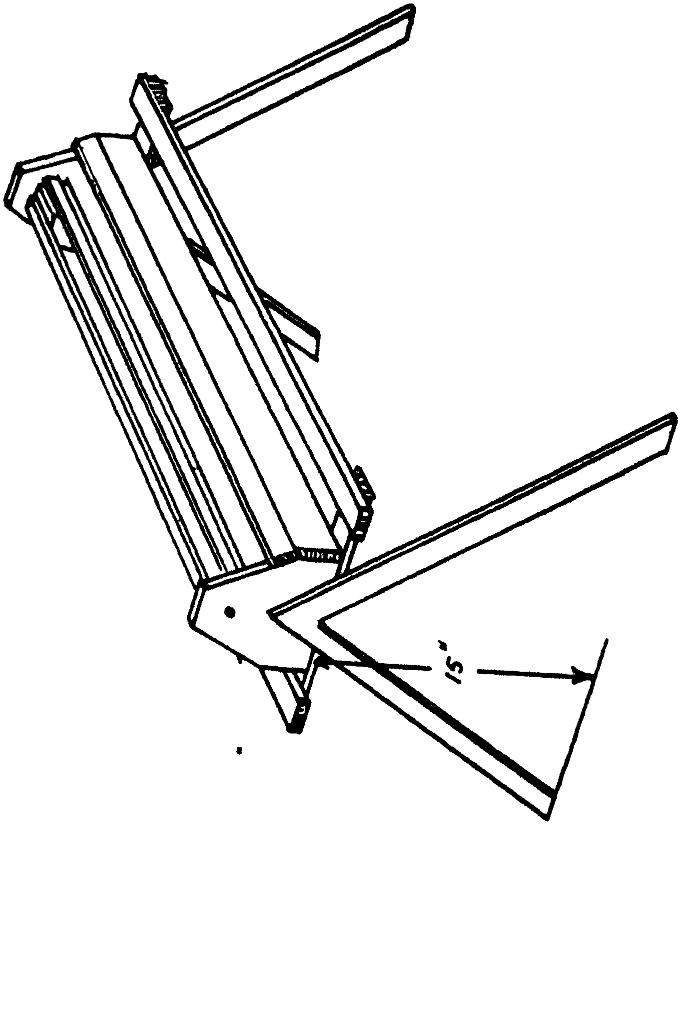
been set aside for rearing should be planted preferably with a permanent grass such as couch. This serves to sweeten the land during the off season and furnishes green pickings for the chicks and two or three cuttings of grass of desirable length during the rainy season for use in the brooders.

When the chicks are eight weeks old give them a mixture of larger grain, such as cracked wheat or crushed mealies mixed with munga and small sunflower seed. By the time the chicks are six to eight weeks old the principal dangers of chickenhood are past, and at this stage they may be removed or weaned from the brooder to suitable coops. The rearing can be continued in wire runs or by the colony system.

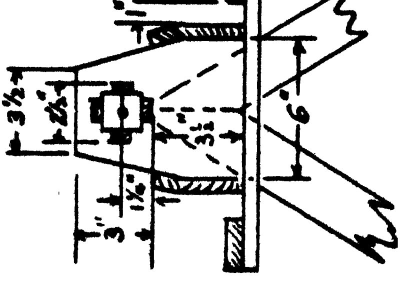
The chickens may, when old enough, be allowed free range under the colony system where they can have freedom under natural conditions, but they must be provided with nourishing food *ad lib.* to ensure steady, healthy, continuous growth. Guard against insect vermin and keep the coops clean and dry.

Chickens intended for laying or breeding purposes should be carefully selected when young, the first selection being made when they are eight weeks old. Separate all the cockerels and house them separately from the pullets. Those showing retarded growth should be separated from the more robust ones and placed in a pen for fattening. A regular practice of culling the young stock is advocated by which essential economies may be effected. The stock showing evidence of lack of stamina and the cockerels having standard defects should be drafted from time to time to the fattening pens for disposal.

Dry mash hoppers are of the greatest advantage in feeding poultry of all ages. By using hoppers for the dry mash, time and labour will be saved. This method of feeding is the cleanest, easiest and best way to feed poultry. The hoppers should be replenished daily, or in the case of self-filling hoppers less frequently, depending upon size of flock. The chickens should have access to the food all day and sufficient hopper space must be provided to enable all the chickens to feed comfortably without overcrowding and molesting each other. Double-sided hoppers are recommended 4 ft. long for 100 chicks and an intermediate size for half



A double sided hopper.



grown stock should be 6 ft. long. The size of hopper accommodation required should be based on the equivalent of one inch per bird.

The value of green food throughout the whole year cannot be too strongly emphasised either in a fresh succulent form or supplied as leaf meal in the mash. Leaf meal may be soaked in water for an hour and fed to the birds after draining in place of succulent green food.

At the age of five months on reaching laying maturity they should be fed on a mash and grain mixture for adult stock.

There are so many grains and meals obtainable in Rhodesia which are suitable for feeding to poultry that a good ration may be made up to suit the poultry farmer from the variety of foodstuffs available. The accompanying rations consist of foodstuffs that are generally easily available and have proved satisfactory. The digestibility, general analysis and palatability of the constituents are important and must be taken into consideration in compiling efficient rations. Other farm-grown foodstuffs may be substituted, but they have been found less palatable and more indigestible as a rule. To supply young stock with food that does not furnish the necessary nutritional requirements or that is not palatable and of good quality is wasteful or would seriously retard their growth. In the case of laying stock lowered productivity would be the result.

During the early stages the rate of growth of the chick is chiefly limited by its capacity for the consumption of food, and although there is at present no data available by which to determine the exact requirements of the chick for protein and carbohydrates, it has been found there is little possibility of over-feeding a chick in its early stages of growth and that the food mixtures usually given to chicks during the early stages are deficient in protein.

The following ration based on these observations has given excellent results. The chickens grow and feather more quickly and the rearing mortality is reduced to a minimum.

With a view to simplifying chick rearing, the following ration was tested at the Salisbury Experiment Station, where

it has since been used for a number of years in the rearing of light and heavy breeds of fowls. The results have proved so satisfactory that this ration can be recommended.

CHICKEN REARING RATION. HATCHING TO MATURITY.

Mash Mixture.

Bran	10 lbs.
Pollard	17 lbs.
Mealie Meal	45 lbs.
Oats (rolled or meal)	10 lbs.
Meat or Fish Meal (to 12 weeks)	10 lbs.
Monkey Nut Cake (ext.)	10 lbs.
Milk, thick separated if available to 10 weeks (optional).	
Bone Meal	2 lbs.
Salt (fine)	½ lb.
Lime (limestone or powdered oyster shell)	1 lb.
Charcoal	1 lb.

Grain Mixture—from 8 weeks.

Crushed Maize	60 lbs.
Munga	30 lbs.
Sunflower Seed (optional)	10 lbs.

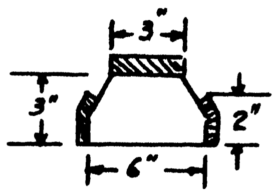
The above mash may be fed alone during the early stages of growth, or in addition munga as a grain feed may be given from the first week to 8 weeks old, thereafter add crushed maize and small sunflower seed, the latter being optional.

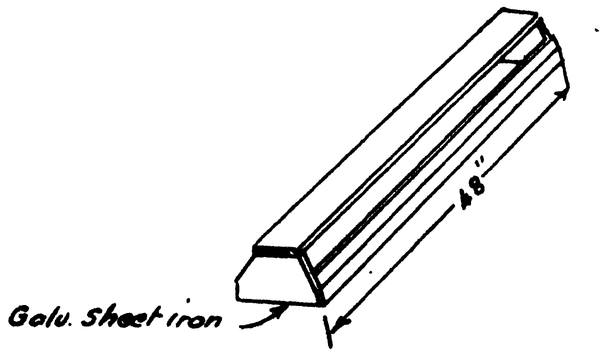
From 12 weeks onwards omit meat or fish meal, the other ingredients remaining the same.

When thick separated milk is available reduce the meat meal to 5 lbs. In the event of oats being too costly substitute by increasing the maize meal and bran each by 5 lbs.

A liberal supply of green food is essential for all ages of growing stock, especially when white maize is used. Part may be mixed for convenience in the mash in the form of lucerne or sunflower leaf meal in addition to succulent green food given daily.

General Observations.—The mortality of young chicks is not always due to disease and parasitic vermin; losses may occur from several other causes which are often overlooked and can be forestalled.





Overcrowding and Chilling.—The brooding of chicks in quarters that are comparatively restricted is accompanied by some danger of overcrowding and suffocation. When the chicks are too cramped and without sufficient ventilation suffocation may result, particularly at night. Overcrowding occurs also outside the brooder during cloudy weather and chilling may result, such as when they are unable to find their way back to the brooder chamber; also young chicks that are exposed too long at sunset or exposed too early in the morning may become chilled. It is particularly important to avoid possible chilling during the day and overcrowding at night when the chicks are very young.

Another source of danger arises on removal of the chickens from the brooders. During the first few nights careful observation would be well repaid, as they will crowd together, especially in chilly weather, or they may not find

their way back into the new quarters. If left outside overnight mortality will result. At this stage overhead protection placed about 2 ft. above the floor, to take the place of the hover, and having the corners of the pens rounded off, are necessary precautions to avoid losses.

Bowel Trouble.—The derangement of the digestive system of young chicks is caused by a number of conditions including chilling, improper feeding, sun-warmed water, overheating or stale and inferior quality foods. Digestive disorders during the early stages of growth may be the result of feeding the chicks too soon after hatching or of allowing them access to moist mash that has fermented. Always supply clean water, fresh wholesome food and provide shade for the chicks and drinking water.

Sanitation.—Sanitation checks disease and must be regarded as one of the important considerations in successful chick rearing. Many common diseases and troubles of both old and young stock can be avoided by following sanitary principles. Proper sanitation means raising chicks on fresh ground, moving portable brooders from place to place at intervals, or in the case of permanent runs digging them over and growing a crop during the off season. Contaminated ground should be treated with lime during the rainy season. Renewing the litter in the brooders as often as necessary and consistent cleaning of utensils and disinfecting brooders after each lot of chicks are weaned are essential points in sanitation.

Cannibalism or Toe Picking.—This is frequently very difficult to deal with, and when an outbreak occurs every effort should be made to nip the trouble in the bud. As a rule one or two birds are the culprits and others simply join in the feast, and it is only by close observation that the ringleaders may be detected, and if removed in time it is probable no further losses would occur.

Cannibalism is often associated with poor hatches and unthrifty stock. The latter may be brought about by too close confinement in the brooders and runs followed by monotony or by providing insufficient hopper accommodation. Under such conditions the tendency for the chicks to peck

and bully and injure one other is greater. These are the most common causes of cannibalism, and the danger under these circumstances becomes a very real one.

Much of this trouble can be avoided by furnishing the chicks with proper nourishment and brooding them in smaller units. There should be no delay in culling the weak stock, separating the sexes and transferring them to larger quarters. Anything that can be done to keep them busy deserves consideration, such as encouraging them to forage about in the runs, the feeding of grain in litter and hanging up in the runs several bunches of green food within easy reach. These are methods to encourage scratching and exercise and in this way healthy chicks are produced.

The low mechanical efficiency with which a steam engine converts heat into energy is perennially shocking to each generation of schoolboys, but the wastefulness of the steam engine is nothing compared with the waste of Vitamin C which takes place between the time a green vegetable is harvested and its final disappearance from the diner's fork. —*Dr. Magnus Pyke.*

Southern Rhodesia Veterinary Report.

JULY, 1941.

DISEASES.

Anthrax was diagnosed on Tana Farm, Selukwe native district.

TUBERCULIN TEST.

Twenty-seven bulls, 151 cows, 226 heifers and 7 calves were tested on importation. Two cows reacted and were destroyed. There were two doubtful reactors, these have been held for re-testing.

MALLEIN TEST.

Ten horses were tested with negative results.

IMPORTATIONS.

Union of South Africa.—Cows, heifers and calves, 391; bulls, 28; horses, 10; sheep, 707; pig, 1.

Bechuanaland Protectorate.—Slaughter cattle, 502; sheep and goats, 819; pigs, 64.

EXPORTATIONS.

P.E. Africa.—Slaughter cattle, 120.
Bechuanaland Protectorate.—Bull, 1.
Northern Rhodesia.—Pig, 1.
Belgian Congo.—Cows, 83.
Kenya.—Bulls, 3.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

United Kingdom.—Beef quarters (chilled quality), 2,392; sides, 320; buttocks, 280; rumps, 486; tongues, 9,589 lbs.; livers, 5,977 lbs.; tails, 1,563 lbs.; kidneys, 97 lbs.; fillets, 802 lbs.

Northern Rhodesia.—Beef carcases, 213; mutton carcases, 52; pork carcases, 24; veal carcases, 2; offal, 9,022 lbs.

Belgian Congo.—Beef carcases, 76; pork carcases, 20; veal carcases, 7; offal, 1,318 lbs.

Meat Products from Liebig's Factory, West Nicholson.

Union of South Africa.—Corned beef, 585,684 lbs.; tongues, 1,350 lbs.; Vienna sausages, 3,960 lbs.; beef and vegetable rations, 10,920 lbs.; ideal quick lunch, 3,864 lbs.; lunch rolls, 3,470 lbs.; beef and ham rolls, 720 lbs.; meat paste, 6,508 lbs.; beef fat, 50,000 lbs.; meat meal, 60,000 lbs.; ham and tongue rolls, 180 lbs.

Northern Rhodesia.—Meat meal, 2,000 lbs.; bone meal, 2,000 lbs.

Belgian Congo.—Bone meal, 30,000 lbs.

Bechuanaland Protectorate.—Bone meal 30,000 lbs.

Sierra Leone.—Corned beef, 3,600 lbs.

Tanganyika.—Lunch rolls, 159 lbs.; ham and tongue rolls, 159 lbs.

Sudan.—Corned beef, 432 lbs.; Vienna sausages, 15 lbs.; ideal quick lunch, 24 lbs.; meat paste, 102 lbs.; beef fat, 2,500 lbs.; cocktail sausages, 75 lbs.; pate de foie gras 44 lbs.; ham and tongue rolls, 45 lbs.; chicken and ham rolls, 77 lbs.

Kenya.—Lunch rolls, 138 lbs.; steak, kidney and onion, 24 lbs.; Oxford sausages, 48 lbs., ham and tongue rolls, 425 lbs.; chicken and ham rolls, 324 lbs.; jellied chicken, 270 lbs.; curried chicken, 120 lbs.; roast chicken, 30 lbs.

P.E. Africa.—Tongues, 30 lbs.; lunch rolls, 31 lbs.; beef and ham rolls, 16 lbs.; steak, kidney and onion, 24 lbs.; meat paste, 31 lbs.; assorted beef rolls, 36 lbs.; cocktail sausages, 60 lbs.; pate de foie gras, 132 lbs.; ham and tongue rolls, 51 lbs.; chicken and ham rolls, 67 lbs.

B. L. KING,
for Chief Veterinary Surgeon.

SOUTHERN RHODESIA
Locust Invasion, 1932-41.

Monthly Report No. 104. July, 1941.

Red Locust (*Nomadacris Septemfasciata*, Serv.).—Very few reports of locust movements were received during July, the following districts being involved, namely, Lomagundi, Salisbury, Marandellas, Mrewa, Mtoko and Melsetter (Chipinga section).

All except one of the swarms were described as "large" or "very large."

July is commonly a quiet month for locust activity in Southern Rhodesia. There has been no indication of any disease or notable parisitization amongst the locust since May, when the swarms were numerous, nor any report of unusually heavy attack by birds, and it appears possible that a considerable proportion of the swarms may have moved into more or less uninhabited country, in which case they are likely to put in an appearance again later in the year.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA
Agricultural Journal

Vol. XXXVIII.] No. 10 [October, 1941

Editorial

Notes and Comments

New Wheat Varieties—Jubilee and Pioneer.

The Department of Agriculture is anxious that growers of Jubilee and Pioneer wheat should retain all the seed reaped by them for sowing next season, or for sale as seed. These varieties have shown great promise and, as seed is not obtainable in commercial quantities, it is desired that they should be bulked up as quickly as possible. Growers of these varieties who have surplus seed for sale are requested to inform the Agriculturist, P.O. Box 387, Salisbury.

Stramonium.

Following the publication in the last issue of this Journal of an article on the production of stramonium, a communication has been received from the Imperial Institute and is printed below.

"As regards the market, it may be said that there is at present a good opening for material from Southern Rhodesia, provided the quality is satisfactory. The Continental sources from which most of our pre-war supplies were obtained have, of course, been cut off but other countries, especially India, have taken on production, and as the crop is easily grown and has a fairly wide climatic tolerance the risk of over-

stocking the market must always be kept in mind. Cultivation on a very large scale would not therefore be advisable and, furthermore, growers should realise that with the re-opening of the European sources of supply after the war they are likely to meet with very strong competition from low priced material. Production of the drug should therefore be regarded as a war-time measure, and no assurance can be given that it will continue to be an economic proposition when peace is resumed."

"As far as price is concerned it is difficult to make any forecasts. In normal times stramonium leaves are offered at between 30s. and 40s. per cwt., but lately, owing to a shortage, the Indian material has been selling at about 110s. per cwt. Under present conditions it seems likely that these higher prices will be maintained for the time being, but if supplies come forward from other Empire countries some drop in the level may be expected, especially as the demand for the drug is limited."

Effect of Stands on Yield of Maize:

"*Perfect versus Reduced Stands of Maize.*—These experiments, which have annually been carried out on duplicate plots, have been in progress for four years and will be discontinued. Their object has been to demonstrate the extent to which the eventual yield per acre is influenced by a good as compared with an indifferent stand of plants. Poor stands of plants are almost invariably the direct result of poor farming. They may be due to an improperly prepared seed-bed, to faulty mechanism in the planter, to the use of seed of irregular size, to seed of low vitality or to the depradations of insect pests and vermin. Much more rarely in this Colony they may be attributed to drought, and the reduction in stand due to this cause is generally small, provided care has been taken to guard against the other contributory factors. The following are the average yields for the period over which the experiment has extended ,and in which, owing to two seasons being abnormally dry, it might have been expected that a thinner rate of planting than that regarded as the optimum would have shown to advantage:—

Distance of planting, 40 x 15 ins.	Average yield in bags per acre over four seasons.
Perfect stand	14.79
90 per cent. stand	13.5
75 per cent. stand	11.8
60 per cent. stand	9.85

Careful observations made throughout the Rhodesian maize belt show that on many farms the average stand of maize is often not much above 60 per cent. of the optimum; the figures given above indicate very plainly to what an extent the possible yield is reduced when this is the case."

The above statement is taken verbatim from the Annual Report of the Salisbury Experiment Station for 1923-24. Recent observations have confirmed the facts and results given which are considered of sufficient value to warrant reprinting. Particular stress is laid on the necessity of planting good healthy seed. Diseased seed has been found to be responsible for much of the imperfect germination and resultant poor stands. With the planting season looming ahead and maize farmers making every effort to increase yields per acre, this factor of maximum stand is of vital importance and may well make the difference between a profitable and an unprofitable crop.

The Survival of Diplodia in Maize Compost.

The Senior Plant Pathologist has supplied the following note on a report which he has just received of an investigation by Miss Everdina E. Wijers, of the Plant Pathology Section, Agricultural Research Institute, Pretoria, into the possible survival of maize cob-rotting fungi (principally *Diplodia zeae* and *Gibberella* spp.) in compost made from maize trash. This work was aided by a grant from the Southern Rhodesian Government and has to a very large extent cleared up the uncertainty with regard to methods to be used for the disposal of infected residue from the maize crop.

Two series of experiments were laid out—one at the Towoomba Experimental Station, Warmbaths, and the other

at the University Experimental Farm, Pretoria. Compost was made from maize trash plus other vegetable refuse together with either kraal manure or artificial starters. The material was kept damp in large pits, turned three times at monthly intervals and finally piled in heaps to mature. Maize trash heavily infected by "Diplodia" diseases was made up into parcels, which were buried at random 2 to 3 feet deep in the compost, the temperatures of the fermenting matter being ascertained by means of recording thermometers. Parcels of diseased maize trash were used for controls and were placed on the top of the compost or on the ground near the pits.

After three weeks, the first basket of infected material was removed and examined, the eleven remaining baskets being similarly dealt with at weekly intervals. The material was examined in the laboratory for possible survival spores of *Diplodia zeae* and *Gibberella* spp., which cause, respectively, the well-known dry rot and pink ear rot of maize.

The results obtained are very interesting. After three weeks in the compost pit, during which time temperatures varied between 120° and 140° F., as many as 30 spores of *Gibberella* in a parcel of infected trash were found to be alive and germinated on suitable treatment. No spores of *Diplodia zeae* were found to have retained their powers of germination. After five weeks, *Gibberella* spores were still viable, but after six weeks, although spores could be detected, all were killed. Many other fungi were growing actively at this stage, but none which is known to be parasitic on maize. They were evidently organisms responsible for the fermentation and break-down of the compost. The control baskets, which were not subjected to the composting process but placed outside the pits, were found to contain living spores of both fungi after 15 weeks' exposure to sun and rain.

In the second experiment it was found that after six weeks near the top of the compost pit material infected by the pink ear rot fungus still contained living spores, although they had been subjected to a temperature of 135° F. It is therefore apparent that *Gibberella*, at least, is capable of surviving six weeks in a compost pit under conditions which have usually been regarded as lethal to fungi, but is unable

to withstand the same conditions for two weeks longer. It is suggested in the report that the destruction of parasitic fungi in crop residues is probably due to factors other than high temperatures alone, and that the final destruction is more likely to be brought about by the antagonistic action of the various moulds which set up fermentation. High humidity is also regarded as assisting the process of destruction.

It is finally concluded—"that *Diplodia* and *Gibberella* infected mealie trash can be safely used in the preparation of compost provided that the pit or heap is left at least eight weeks to ripen."

The implications should be obvious, namely, that in the preparation of compost from maize residues care should be taken to see that all the material is, in fact, composted and that the outer layers and general litter are placed well into the centre at each turning of the heap. Otherwise infected material is certain to be returned to the lands with the compost.

The 1941 Wheat Crop.

According to the preliminary estimate of the 1941 wheat crop given in a recent Economic and Statistical Bulletin, the season has proved a disappointing one owing to the early cessation of the rains. The number of growers is estimated to be 354 (68 less than in 1940) and the area planted 17,397 acres (a decrease of 2,421 acres). From the information available it is estimated that the crop will not exceed 48,000 bags, approximately 6,000 bags less than in 1940. This lower crop is the result of the reduction in acreage rather than in the yield per acre, which for non-irrigated wheat is expected to be 2.2 bags per acre compared with 2.3 bags in 1940. Irrigated wheat seems to be experiencing the most favourable season for many years, the anticipated yield being 4.7 bags per acre compared with 4.3 bags in 1940.

The following table analyses by districts the number of growers who have stated the various types of wheat they are cultivating. It will be seen that for the current season (1941) the favourite is Punjab, followed by Montana, Karachi, Klein Koren, Kenya Governor, etc. During 1940 the favourite

varieties in order of popularity were Karachi, Punjab, Kenya Governor, Klein Koren and Early Gluyas. The types vary greatly from district to district and from season to season, showing that most varieties are still experimental.

District.	Punjab.	Montana.	Karachi.	Klein Koren.	Kenya Governor.	Early Gluyas.	Pilgrim.	Burbank or Quality.	Witels.	Sabanero.
Victoria and Ndanga	3	—	—	—	9	—	—	—	—	—
Chilimanzi...	17	4	2	3	—	8	—	1	—	1
Mazoe	—	—	2	—	—	—	—	—	—	—
Salisbury	5	5	4	6	—	—	—	—	3	2
Charter...	4	18	11	17	—	2	1	6	6	2
Gutu...	12	8	8	1	2	1	—	1	—	—
Melsetter	—	—	—	—	4	—	1	2	—	2
Umtali	—	—	—	—	1	—	3	—	—	2
Other districts ...	2	—	1	—	1	—	6	—	1	1
Total	43	35	28	27	17	11	11	10	10	10

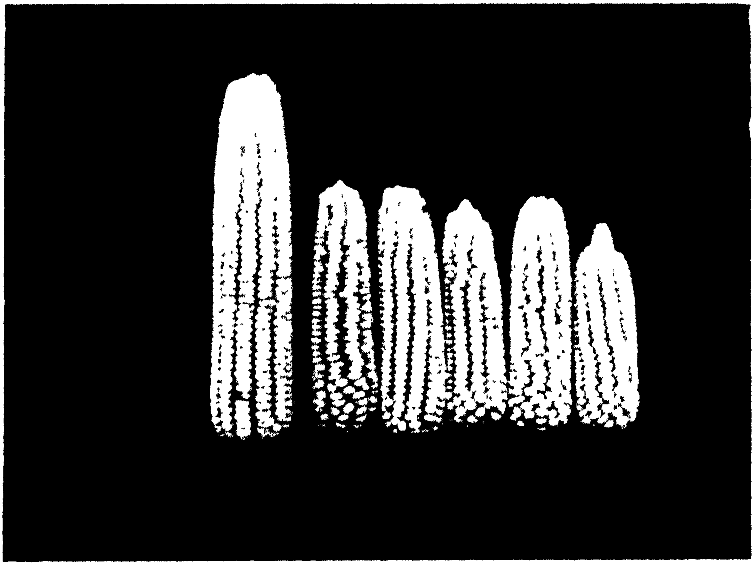
Importation of Tobacco Seed and Leaf.

Government Notice No. 433 of 12th September, 1941, makes some slight alterations in the regulations regarding the import of tobacco seed and unmanufactured tobacco leaf. The position now is as follows:—

From the Union of South Africa, the Belgian Congo, Northern Rhodesia, and Nyasaland, importation is allowed under Special Permit issued subject to the application of any precautionary measures that may be considered expedient, *e.g.*, seed treatment, fumigation of leaf, etc.

From any other country, importation is allowed under a similar permit, except that imports from countries where blue mould or downy mildew is known to exist are restricted to imports made by or under the direct supervision of the Department of Agriculture.

Tobacco leaf includes trade samples.



Ears from inbred line, S33/3/3. Ears on right from selfed grain. Large ear on left from a grain which had been accidentally crossed.

Hybrid-Maize.

By ALAN RATTRAY, B.A., Junior Agriculturist.

The rapidly increasing popularity of strains of hybrid maize in the United States, and the unreliable results often obtained by mass selection, have resulted in other maize growing countries either starting or at any rate investigating the possibilities of work along the same lines. With this object in view, a certain amount of breeding was begun on the Salisbury Experiment Station eight years ago and this has been increased considerably in the last few years.

Whilst mass selection in this country has resulted in the production of definite varieties of maize suited to local climatic conditions and markets, improvement has inevitably been slow because of lack of control over the male, or pollen producing parent, in a crop which is normally cross fertilised. It is expected that the maintenance of a special seed plot, small enough to allow plants showing undesirable characters to be detasselled and eliminated from it, together with the practice of field selection within this plot, will result in an increased rate of improvement. The breeding of inbred or selfed lines for a sufficient length of time to get marked uniformity within each line, and the subsequent crossing of the more promising and compatible strains obtained in this way, is a very much quicker method of attaining the same object. The most noticeable results of inbreeding maize are the loss of vigour, the appearance of greater uniformity within each line and the intensification of the different plant characters, making it very much easier for the breeder to discard those strains which are defective or lacking at some point. It is the first cross between two inbred strains which is popularly known as "hybrid" maize, and the most successful hybrids may yield 20 to 30 per cent. more than the open pollinated varieties from which they originated.

The production of hybrid seed would seem, therefore, to be the obvious solution to the problems of seed selection; but

there are one or two drawbacks. The most important of these is that it is only the first generation of the cross that shows superior yielding ability, and in consequence growers must be able to obtain fresh supplies of seed each year. Insufficient work has been done as yet in this country to make any accurate forecast of what the cost of such seed might be, but it is thought that the extra profit resulting from the increased yields should more than pay for the higher cost of seed. A further difficulty is the lack of any organisation in this country to carry out this work on a big scale, but no doubt with the assistance of the farmers of the country this can eventually be overcome.

The foundation stock for the breeding work on the Salisbury Experiment Station consisted of 44 ears selected from suitable plants of the Salisbury White variety, but new material is being added continuously. All of these lines or strains are selfed each year, the better plants being re-selected and the poorer ones discarded, so that at the present time the original material has multiplied to some hundreds of strains, the oldest of which have been inbred eight years. Considerable uniformity is already apparent in many of the lines, but there is a great deal of variance between different lines. In some cases the yield has dropped to almost nothing within a couple of years, and these strains are naturally discarded. Yielding ability and resistance to disease, both of the ear and the foliage, are the chief factors on which re-selection is carried out, but there are many other lesser characters which have to be considered. Some strains have longer sheaths and better covered ear tips than others, some are more firmly anchored in the ground, but perhaps the most striking differences are to be found in the ear types and the amount of diplodia and other fungous ear rots present. These serve to convince the breeder that improvement of any particular plant character can be accomplished by selection; but naturally, selfing, which is the most intensive form of inbreeding, shows up defects and desirable characters quicker than any form of open field selection.

Simultaneously with the inbreeding, a programme of crossing has been carried out; and hybrids made in any one year are tested the following season as thoroughly as the

limited amount of seed will allow. In all cases comparison is made with control plots for which the best possible seed of an open pollinated variety is used. Careful statistical analysis of the results obtained in these trials have proved some of the strains to be capable of yielding 20%, 30% or even a greater percentage more than the controls. Owing to the amount of variance still existing in most of the inbreds, and in consequence a variance in the yielding ability of individual crosses made from the same inbred strains, results have not been as consistent as might be desired and trials will be carried on until one or more hybrid strains have proved themselves definitely superior to our open pollinated varieties. The uniformity within some of the hybrids has been most conspicuous, and it is often possible to identify a strain by some particular character. Once a particular hybrid has proved itself, then the parent inbred strains can be bulked up by planting in isolated fields and the production of hybrid seed can be proceeded with on a more commercial scale.

The photograph shows a sample of ears from a particular inbred line, S33/3/3. Those on the right are from selfed grain, whilst that on the left arose from a grain which had been accidentally crossed. It gives an idea of the vigorous type of ear produced as a result of crossing inbred strains. Note the uniformity among the selfed ears.

MARY.

Mary had a little lamb
Whose fleece was white as snow,
For Mary knew that cleanliness
Prevents all kinds of woe.

The same knowledge applies to cleanliness in land, yard, store and orchard.

Cleanliness Aids Insect Control.

The Natural Resources Act, 1941

By the Hon. Sir Robert McIlwaine, M.A., LL.B., K.C.

In moving the second reading of the Natural Resources Bill—now the "Natural Resources Act, 1941"—in the Legislative Assembly, the Hon. the Minister of Agriculture and Lands referred to it in words to the effect that it was the most important measure he had sponsored during his seven years of office.

It is not proposed to deal here with the details of the Act, section by section: these can best be obtained by reference to the Act itself. This article is intended to summarise its general history, aims and principles.

The object of the Act, as set out in the preamble, is "To make provision for the conservation and improvement of the natural resources of the Colony."

The definition of "natural resources" is extremely wide. It not only embraces those things which minister to man's material wants, but it may also be extended to embrace landscapes and scenery deemed worthy of preservation on account of the beneficial influence which pleasant natural surroundings may have on character and outlook.

History shows us that many parts of the earth, once richly endowed by nature and carrying large populations, gradually became barren wastes through men's failure to preserve and make a wise use of their natural resources. With these object lessons before us, there should be willing help and co-operation in carrying out any measures designed to preserve this country from similar evils.

However important minerals and other forms of Nature's gifts may be, there is no doubt but the chief wealth of a country resides in its soil—chiefly the few inches of top-soil. To make this wealth available there must, of course, be an adequate supply of water.

It may not be out of place here to refer to circumstances leading up to the passing of the present Act. As far back as August, 1909, the Honourable Lionel Cripps, in an article entitled "The Erosion of Soil," called attention to the evil and suggested certain remedies. The subject was again dealt with in 1921 by the Government Irrigation Engineer, Mr. A. C. Jennings, in an official Bulletin "Soil Washing." A few progressive farmers realised the necessity of taking steps to protect the soil but, on the whole, little was done until 1931, when the Rhodesia Agricultural Union at its annual Congress appointed a special committee "To enquire into the factors causing soil erosion and to formulate suggestions for the prevention thereof."

The outcome of the Agricultural Union's efforts was the appointment by the Minister of Agriculture of Soil Conservation Councils, one for Mashonaland and one for Matabeleland. These Councils, in conjunction with the officers of the Government, did much useful work, but they had no statutory authority.

I hesitate to introduce the following personal reference. After a long residence in the country and an intimate acquaintance with most parts of it, acquired in my travels as Water Court Judge, I was so concerned with the rapid deterioration that I saw taking place that in 1938 I felt impelled to write a strongly worded minute to each Minister of the Government stressing the urgent necessity of taking steps to prevent the waste of the natural assets of the Colony. As a consequence, in September, 1938, a Commission was appointed "to enquire into and report upon the extent to which the natural resources of the Colony are deteriorating or being wasted through various causes." The Act now under consideration was framed as a result of the report of the Commission and is designed to give effect to its chief recommendations.

The Act is divided into five parts.

PART I.

Natural Resources Board.

It is provided that there shall be a Natural Resources Board appointed by the Governor consisting of a chairman

and not less than three other members. In making appointments regard will be had to the special interests concerned, and such interests may submit a panel of names of persons considered suitable. For example, representatives of farmers would, no doubt, submit a list of farmers.

The functions of the Board, as set out in section 8 of the Act, are:—

(*a*) to exercise general supervision over natural resources;

(*b*) to stimulate by propaganda and such other means as it may deem expedient a public interest in the conservation and improvement of natural resources;

(*c*) to recommend to the Government the nature of legislation by it deemed necessary for the proper conservation, use and improvement of natural resources.

This section contains principles which the Commission regarded as the keystone of their recommendations. Other sections of the Act give specific powers to the Board in respect of soil conservation and the control of water because of the great urgency of dealing with these problems but, as will be seen, section 8 may be regarded as constituting the Board the Public Trustee for the natural resources of the Colony. It will be its duty to keep itself advised on all matters touching these resources and where powers governing their conservation, use or improvement are absent or inadequate, to make recommendations to the Government as to the legislation deemed necessary on that behalf. The report of the Commission indicates the need of such legislation in respect of forestry, minerals, wild life, etc.

The Act provides that, when the Board is dealing with any question where the interests of natives in native reserves or native areas may be affected, the Governor may nominate someone to represent such interests. In the same way a Minister may appoint a person to present his views to the Board on any matter affecting his department. When any matter arises entailing the consideration of professional or technical questions, the Board is required to consult persons qualified to advise thereon.

The Board shall, at the request of the Minister, report on soil and water conservation projects and no public revenue shall be spent on any such project which involves an estimated expenditure in excess of £3,000 unless the Board has reported in its favour.

It is anticipated that the Board will be of such status and have such a sympathetic understanding of the many questions with which it has to deal that its decisions will be so reasonable and helpful that they should generally give satisfaction; on the other hand, it was felt that the powers entrusted to the Board are so wide that it was desirable to provide for a tribunal to which any person who considered himself aggrieved by its decision could appeal, consequently provision has been made for an appeal to three referees appointed by the Governor, one of whom shall be a judge of the High Court. In appointing the other two, regard shall be had to the lists of persons submitted by interests concerned under section 4 (2) of the Act. The referees will have power to confirm, vary or set aside the finding of the Board. Provision is also made for the obtaining of rulings of the High Court on questions of law.

In order that the people may be kept informed of the activities of the Board, it is required to submit for presentation to Parliament an annual report upon its work, in which will be shown to what extent recommendations made to the Government or a Minister have been adopted.

PART II.

Conservation and Improvement of Natural Resources in Areas other than Native Reserves.

This part of the Act does not apply to native reserves, which are provided for in a separate chapter. Its provisions are extensive and important. Section 22 authorises the Government to set aside Crown land or acquire other land for the improvement or conservation of natural resources. For example, it has been clearly established that the spread of cultivation and intensive stocking over the catchment area of streams, with the consequent denudation of soil cover, leads to the drying up of springs, the cessation of the permanent flow of streams and the advent of destructive silt-laden floods.

It will now be possible to set aside such areas and preserve them for the fulfilment of their natural protective functions.

The Minister may, on the recommendation of the Board, construct and maintain upon any land works for the following purposes:—

(*a*) the protection of the source, course or feeders of a public stream;

(*b*) the disposal or control of storm water;

(*c*) the mitigation or prevention of soil erosion;

(*d*) the conservation of water.

The cost of works constructed by the Minister are in the first instance paid for from public funds, but if the Board is of opinion that part of such costs should be borne by landowners benefiting from the works, it shall fix the contribution to be paid by them. If the landowner fails to pay on demand, the amount fixed becomes a charge upon the land and, unless paid sooner, shall be recoverable in equal annual instalments over a period not exceeding 50 years. Unpaid amounts carry interest at a rate not exceeding 5 per centum per annum.

As it is probable that the Board will frequently have to exercise the powers conferred on it by section 26, the following provisions setting out these powers are quoted:—

"26. (1) If after paying due regard to all the circumstances the Board considers that such a course is necessary for the conservation of soil, water and vegetation on any land and is just and equitable, it may give written orders to the owner or occupier of such land to undertake or adopt such measures as it may deem necessary for the conservation of soil, water and vegetation on such land and the prevention of injury to the soil, water and vegetation on other land by the acts or omissions of such owner or occupier.

(2) Such orders may relate only to—

(*a*) the construction and maintenance of soil conservation works;

(*b*) the preservation and protection of the source, course and banks of rivers and streams;

(*c*) the depasturing of stock;

(*d*) the method of cultivation of the land;

(*e*) the prohibition or restriction of cultivation of any part of the land;

(*f*) the control of water, including storm water."

It is a punishable offence to fail or neglect to carry out orders given under paragraphs (*b*), (*c*), (*d*) or (*e*). When orders under paragraphs (*a*), (*b*) or (*f*) necessitate the construction of works, the Minister may, on the recommendation of the Board, lend the landowner money for the purpose, or construct the works at his expense, suitable provision being made for the recovery of the indebtedness.

PART III.

Conservation Areas.

It may be that some communities will desire to proceed with conservation and improvement schemes in their particular area apart from and at a faster rate than can be attained under the general provisions of the Act. It is provided under this part that the Minister may, on the recommendation of the Board, declare any such locality an intensive conservation area if not less than two-thirds of the landowners concerned consent to or do not oppose such a course. A conservation committee elected by the landowners from among their numbers would be authorised, subject to the approval of the Board—

(1) to inaugurate and undertake the construction of works and other measures for soil and water conservation and improvement of soil and water supplies in its area;

(2) generally to co-operate with and assist the Board in carrying out the objects and purposes of this Act;

(3) to construct and maintain such works as it may deem necessary for soil and water conservation or improvement; and

(4) to superintend or perform, or enter into contracts for the superintendence or performance of, all such

acts, matters and things as are incidental to soil and water conservation, maintenance or improvement.

Suitable provision is made for the distribution of costs among the persons benefiting by the committee's undertakings and loans, subsidies or grants-in-aid may be made to such committees.

PART IV.

Conservation and Improvement of Natural Resources in Native Reserves.

A great deal of useful conservation work has been carried out under the direction and supervision of officers of the Native Department, but hitherto the legal authority necessary for their purposes has been wanting. It is now provided in section 38 as follows:—

"38. (1) If a Native Commissioner considers that such a course is necessary for the conservation of natural resources on any land, he may give orders to the users of such land to undertake or adopt such measures as he may deem necessary for the conservation of natural resources on such land and the prevention of injury to the natural resources on other land by the acts or omissions of such users.

(2) Such orders may relate to—

(*a*) the depasturing of stock;

(*b*) the method of cultivation of the land;

(*c*) the prohibition or restriction of cultivation of any part of the land;

(*d*) the control of water, including storm water."

There is no doubt but a Native Commissioner in giving orders under this section would be guided in certain matters by experts on the subject. There is provision for an appeal to the Board from a Native Commissioner's order.

There are certain areas in the Native Reserves that can only be regenerated and saved from becoming useless wildernesses by being entirely withdrawn from occupation and there are other places where extensive deterioration is taking place through overstocking, with great resultant cruelty to stock. As in the case of land outside the Native Reserves, there are

many places within them where the protection of watersheds is necessary. This part of the Act makes provision for dealing with the foregoing situations.

The Government, in its efforts to improve conditions in Native Reserves, goes to considerable trouble and incurs much expense in constructing soil conservation works, yet it often happens that natives directly benefiting from contour banks and drains, which protect their individual pieces of land, not only do not maintain them in good order, but actually destroy them by digging for rats and allowing cattle and sledges to injure them. This position is now provided for.

PART V.

GENERAL.

This part of the Act in addition to providing for the appointment of conservation officers, rights of entry, penalties, and the making of regulations for the purposes of the Act, contains an important provision for constituting conservation councils. As already mentioned, the Soil Advisory Councils for Mashonaland and Matabeleland had no statutory authority, but in view of the work performed by them, it was desired to give legal standing to such useful bodies. The present Act provides for the Governor, by Proclamation, appointing conservation councils for the area defined in such Proclamation. Such council shall be representative of the special interests of such area and shall confer with and advise the Board in regard to the conservation and improvement of natural resources therein.

In conclusion, if this Act is administered with the understanding and sympathy necessary to secure the whole-hearted support of the people, it is capable of incalculable benefit to the country. Although there can be no doubt as to the worthiness of its aims, inasmuch as it is legislation of a pioneer nature, it is most probable that a little experience of its working will show directions in which it can be improved. The important advance is the unanimous recognition by the legislature of the necessity of taking all reasonable steps to protect the resources of the Colony and pass them on unimpaired to succeeding generations.

Cultural Measures for Control of Root-Knot Eelworm.

WITH SPECIAL REFERENCE TO TOBACCO.

By R. W. JACK, Chief Entomologist.

The organism known variously as "Root-knot Eelworm," "Root-knot Nematode," "Root Gallworm," or simply as "eelworm" or "nematode,"* continues to increase in importance as a major pest of tobacco, potato and many other crops in Southern Rhodesia. In sober fact, the increasing incidence of this pest in tobacco lands is a matter giving cause for anxiety.

An article on "Tobacco Root-knot Nematode" by Mr. J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station, appeared in the *Rhodesia Agricultural Journal* for May, 1937, but in the bulletin form is now out of print. Mr. M. C. Mossop also contributed a short article on "The Life History of Root Gallworm or Root-knot Eelworm" to the *Rhodesia Agricultural Journal*, September, 1938. During the past few years additions have been made to available information concerning the effect of control measures based upon cultural practices, particularly in the Union of South Africa, and these should certainly be made generally available to tobacco planters in the Colony.

Symptoms of Attack.—Plants of which the roots are seriously infested with the root-knot eelworm are generally dwarfed and of a paler colour than normal, and they tend to wilt in the hot sun. Examination of the roots will disclose galls or swellings which may be very numerous on the smaller roots, whilst the larger roots may be greatly swollen and covered with lumps. Cutting through the galls reveals the

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**Heterodera marioni* (Cornu), Goodey. [Syn. *H. radicicola* (Greef), Muller.]

presence of the mature female eelworms, which appear to the naked eye as pearly white specks, about the size of a small pin's head, embedded in the tissues. The tissues around the females have a watery appearance.

Care should be taken not to mistake the nitrogen-fixing nodules on the roots of leguminous plants for eelworm galls. Galls produced by eelworm attack are obviously swollen portions of the root itself, whereas nitrogen nodules are small lumps of tissue attached to the side of the roots, usually by a distinguishable "neck."

The damage inflicted on the plant by root-knot eelworm is regarded as being partly toxic and partly mechanical. The proliferation of tissue induced by the presence of the pest in any case tends to cramp and distort the vessels and to interfere with the flow of sap.

Life History.—The root-knot eelworm commences its life as an egg, less than 1/250th of an inch long, which is covered with a tough skin. These eggs are extruded by the female together with a gelatinous substance which binds them together into a mass. This is called the egg sac and remains attached to the body of the mother eelworm.

The eggs are usually extruded within the gall and here they hatch. Under suitable conditions of warmth and moisture this takes place in less than a week. The young eelworm, or larva, may remain within the gall and bore into the root tissue to commence another cycle of development, or, possibly more frequently, it escapes into the surrounding soil. Under suitable conditions, which appear to include approximate saturation of the air in the interstices of the soil, the larva can live free in the soil for a period varying from one to two years, according to various authors. Normally, however, the larva finds a root of one of its host plants and bores into it near the growing point.

In the case of the female the free life of the eelworm is now over. It remains within the tissues of the plant, where it is fertilised by the male. Its presence causes proliferation of the plant tissue and formation of the characteristic galls. After fertilisation the female loses its elongate shape and increases rapidly in thickness, finally becoming the pear-

shaped organism which is visible to the naked eye when the galls are cut open. It is stated to commence egg laying about 20 days after entering the root, but this will doubtless depend upon the temperature of the soil and the type of host plant. The average number of eggs laid by the female is stated to be from 300 to 600, although as many as 1,200 have been recorded under very favourable conditions.

The males also develop within the plant tissue, but remain elongate in shape and return to a free life when mature.

Environment.—The root-knot eelworm occurs as an outdoor pest throughout the warmer zone of the earth. It is in general unable to persist out of doors in the cool temperate zone, where it is, however, a serious pest under glass.

Light sandy soils provide the most favourable environment for the organism, whilst heavy clay loams are least suitable. The pest flourishes, however, in the ordinary red soils of this Colony.

This species of eelworm is intolerant of dry conditions, and in most instances will be found to be particularly prevalent in the lower and damper portions of any piece of land or in other places where the soil tends to retain moisture in the dry season. The pest flourishes notably in irrigated soil and frequently renders such land unfit for the cultivation of other than immune or resistant crops.

The eelworms are stated to be most abundant in the top 12-16 inches of the soil, but may occur sparsely down to a depth of a yard or more. The depth distribution, however, varies with the season and soil conditions.

Host Plants.—The root-knot eelworm has an enormous range of host plants; in fact, it is a much lighter undertaking to list the plants which are not generally attacked than to list those which are susceptible. All such crops as tobacco, potato, sunflower, pyrethrum, beans, the more commonly grown varieties of soya beans, most varieties of cowpeas and kaffir beans, dhal, sweet potatoes, pineapple, cotton, tomatoes, cucumbers and most garden vegetables are subject to attack, as well as a very large number of ornamental plants and

weeds. There are, however, all degrees of tolerance of infestation and resistance, from high susceptibility to practical immunity. Sunflowers, for instance, although subject to heavy infestation, have been stated usually to make good growth in spite of it (Watson, 1921).

Crops or varieties of crop plants which are reported usually to be resistant or only slightly susceptible include:— Maize, sorghum, oats, rye, wheat, munga, wintersome, barley, most of the true grasses, onion, sunnhemp, velvet beans (Florida, Mauritius, Somerset), cowpeas (Iron, Victor, Brabham, Monetta), ground nuts (Valencia, Virginia Bunch, Masumbika, Jumbo), soya bean (Laredo).

It should be clearly understood that few, if any, of the above mentioned plants are completely immune to attack, and that they are not all suitable for rotation with tobacco or other susceptible crop. Some of them are more tolerant than resistant and the eelworm population in the soil can, of course, be built up rapidly on a tolerant host. By "tolerant" is meant a plant which is more or less readily infested with the pest, but suffers little injury from its attack. "Resistant" plants are those which become little infested even in heavily infested soil. "Immune" plants are not attacked at all.

It may be noted that extremely divergent reports are to be found in the literature concerning the susceptibility of different crops and the degree to which they can serve as hosts for the eelworm. This may be due to the fact that different varieties of the same species of plant may differ very considerably in their resistance to attack, whilst even the same variety may exhibit different degrees of resistance under different conditions of soil and climate.

If we take maize as an important example, it used to be regarded as at least highly resistant, but well authenticated instances of serious infestation and injury to this crop have gradually come to light, not only overseas, but in South Africa, and two cases have been reported in Southern Rhodesia (Collins, A. P., 1938; Collins, J. C., 1938). It is now regarded in some quarters as an unsuitable crop for rotation with tobacco in reference to eelworm infestation, but it appears that profitable crops of maize can commonly be grown on

eelworm-infested soil in the Colony. It may be remarked that galls are apt to be inconspicuous on the roots of infested plants of this species.

Collins (1938) also reports attack on *munga* in one instance and marked dwarfing of the plants. He failed, however, to obtain infestation of this crop experimentally during one season. The botanical name of this plant is *Pennisetum glaucum* (Pearl Millet) and all previous records in reference to this species have been negative.

It may be recorded that whilst, during the past thirty years and more, innumerable specimens of plants infested with eelworm have been submitted to the Division of Entomology for diagnosis, there has not occurred a single instance of any plant of the grass family (*Graminae*) being so submitted, nor have any cases of attack in such plants been recorded by the Division from observation in the field.

With regard to weeds, the common "Blackjack" (*Bidens pilosa*) has not been found to be infested by Collins (J.C.1927) in Southern Rhodesia, and serious infestation is not recorded overseas. Smee (1928), however, records infestation in Nyasaland, and the present writer found this species "badly attacked" in an infested potato field in Matabeleland in 1913.

"Mexican Marigold" (*Tagetes minuta*) has not been recorded as infested in Southern Rhodesia, but reports elsewhere indicate that it may be lightly infested.

Natal Red-top Grass (*Tricholaena rosea*) is generally reported to be highly resistant.

Most dicotyledonous weeds must be regarded as under definite suspicion as hosts of this pest.

MEASURES AGAINST EELWORM.

A very large amount of experimental research has been carried out in different parts of the world with the object of finding feasible means of controlling Root-knot Eelworm in agricultural land, but with only limited success. No economic method of *eradicating* this eelworm from infested land is known at the present time. Furthermore, whilst certain chemical treatments of the soil are effective in reducing the

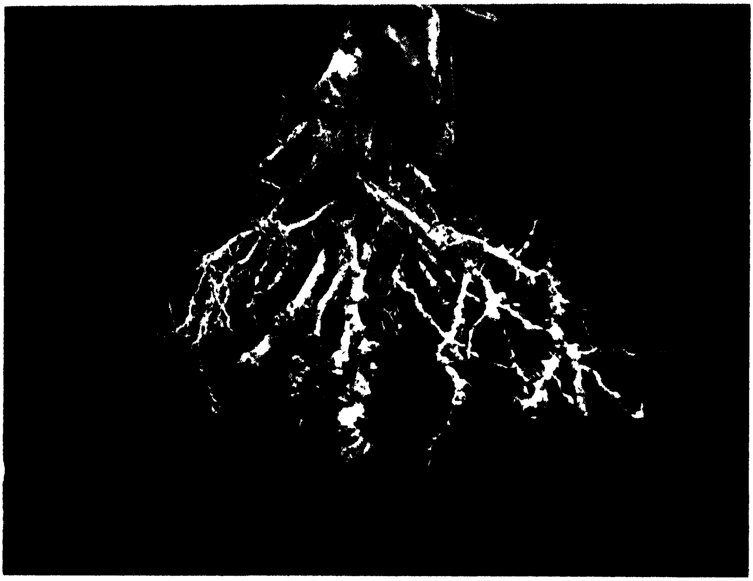

Fig 1 Tobacco root showing galls caused by Root-knot Eelworm.
(Photo by M C Mossop)

Fig 2. Potato infested with Root knot
Eeelworm.
(Photo by M C. Mossop).

eelworm population to a minimum, they involve the application of very large quantities of material and are too expensive for use except under conditions of the most intensive cultivation, or where expense is not a major consideration. The most effective chemical treatments include fumigation of the soil with carbon bisulphide, and the use of cyanogen compounds, *e.g.* (1) a solution of sodium cyanide followed by a solution of ammonium sulphate, or (2) calcium cyanide powder or solution. The cost of these treatments is, however, altogether prohibitive as far as field conditions in this Colony are concerned.

In the circumstances we are forced to direct attention to (1) preventing infestation as far as possible and (2) palliative measures, or, in other words, control.

Preventive Measures.—In dealing with such crops as tobacco, attention must primarily be given to assuring that the *seed-beds* are free from eelworm. This is of the greatest importance. Infested seedlings will, of course, infest the land on which they are planted out. Moreover, whilst clean seedlings under favourable conditions can produce a profitable crop on moderately infested land, infested seedlings, generally speaking, will not produce normal plants even on previously clean land. The earlier the infestation, other things being equal, the greater is the ultimate effect on the plant.

Precautions which reduce the risk of infestation of seed-beds include:—

(1) Use of newly broken land;

(2) Avoidance of sites of old kaffir gardens and kitchen gardens, and the immediate vicinity of such;

(3) Avoidance of sites to which drainage or flood water runs from cultivated land on higher ground;

(4) Frequent change of site;

(5) Avoidance, if feasible, of low-lying sites generally, including the banks of streams;

(6) Watering from a borehole, or, failing that, a well, and not from a stream or pool.

On many farms it is not possible to conform to all of the above. The advice given is in the nature of a counsel of perfection, and it may be added that instances have been reported of infestation of seed-beds where all of the above precautions have been observed. There is a considerable amount of evidence to suggest that eelworm may sometimes be present in the natural vegetation in the Colony, even away from stream banks. If a stream or pool has to be used for watering a small platform can be constructed so that water can be drawn away from the bank, thus avoiding inclusion of mud, etc. The latter may contain eelworms due to the infestation of plants growing on the banks of the stream (Collins, 1937 and 1938). Many streams in the Colony have been suspected of causing infestation of tobacco seed-beds, probably with some justification. No practical method of treating the water to rid it of eelworm has as yet been devised.

Other points to bear in mind in reference to avoiding infestation of any piece of land, including that used for seed-beds, are that eelworms are readily transported by flood water and by soil adhering to implements and to the feet of man and animals. Lands should be protected from flood water by contour drains at the upper end. Implements used on infested land should be cleaned thoroughly before being used on clean land and appropriate measures should be taken in reference to the feet of draught animals and labourers, as well as the boots of Europeans.

The use of compost made with infested roots might, conceivably, introduce eelworm to new land. Compost made from an immune crop such as sunnhemp would be free from this danger, if the soil mixed with it is not infested. If tobacco plants are used for making compost it appears advisable that the roots be cut off and burnt.

Above all, it is to be borne in mind that seed potatoes of African origin are very liable to be infested to a greater or lesser degree with eelworm. Tobacco should never be planted on land on which potatoes have been grown. Purchase and selection of seed potatoes, of course, calls at all times for the greatest care in reference to eelworm infestation.

PALLIATIVE MEASURES.

Thorough burning of seed-beds destroys any eelworms present to a depth of some inches, but can only be regarded as a palliative measure, because lethal temperatures are not produced to a sufficient depth to rid the soil completely of the pest. Seed-bed sites should be cleared of plants as soon as planting is over, and should be ploughed up and kept free from plant growth during the remainder of the wet season and throughout the subsequent dry season.

If seedlings are found to be infested prudence dictates that no plants from the infested beds should be planted out, in order to avoid infesting the land. The grower, finding himself "between the devil and the deep sea," will, however, be inclined or forced to take a chance in certain cases, so as to obtain some sort of crop that season. If he acts on this inclination all obviously infested plants should be discarded and burnt, and only those which are apparently uninfested should be used. Many slightly infested plants are, of course, likely to be included amongst those "passed" for planting and the land on which these seedlings are planted will in all probability become infested.

Heavy manuring or high soil fertility will enable at least certain kinds of plants to resist eelworm attack and good crops of French beans, for instance, have been observed in this Colony to be produced on heavily infested but highly fertile soil. More information is required in the above connection because heavy applications of fertilisers are not generally regarded as of much value against this pest, although it is admitted that they may help in some instances by causing the plant to put out new roots. Plants infested in the seedling stage are stated, in any case, not to respond well to fertilising and manuring (Veitch, 1938). In the case of tobacco in the field it may be worth while to try the application of a nitrogenous fertiliser at fortnightly intervals to backward plants. It is suggested that a hole 4 or 5 inches deep might be made close to the plants with a dibble, a pinch of nitrate of soda or ammonium sulphate inserted, and the hole closed up. The effect of this treatment on eelworm infested plants remains, however, to be ascertained.

The most effective measures tending to check increase of eelworm in tobacco lands include the removal of all living plants as early as possible after the crop is reaped, followed by maintenance of such clean conditions, and the ploughing of the land several times in the dry season, to secure the maximum drying out and exposure of the soil to the sun.

The nematode, even in the egg stage, has remarkably little resistance to dry conditions, and, according to careful laboratory experiments carried out in Hawaii, is also quickly killed by exposure to ultra violet rays. The combination of sunlight, heat and drying kills all stages, including the eggs, in less than half an hour, active nematodes being killed in one and a half minutes (Godfrey & Hoskins, 1933).

An interesting experiment by Godfrey showed that exposure of infested soil in a layer about 1 inch deep for 6 hours only to the July sun in Washington, D.C., resulted in the complete eradication of the eelworm in all stages.

On the other hand, in undisturbed air-dried soil in tubs in the laboratory, the nematodes survived from 20-24 weeks, and, in soil which was frequently disturbed to secure better drying, for 16-20 weeks (Godfrey, Oliviera and Gittel, 1933). These particular experiments were carried out in Hawaii where the atmospheric humidity is normally rather high (average 70% R.H.). Collins, however, found that the eelworm survived 4½ months in air-dried soil in the laboratory in the height of the dry season (20/5/36 to 5/10/36) in Southern Rhodesia (Collins, 1937a.). It is known, in any case, that the air in the interstices of even apparently dry soil in the field is usually near the saturation point, except in the top inch or two.

Living roots will, of course, carry the eelworm effectively over the dry season in the soil, and even dead root tissue in the form of the galls produced by the eelworm protect it to a considerable extent from desiccation and prolong its life in dry soil.

Other experiments carried out in South Africa have demonstrated the value of clean cultivation and ploughing during the dry season, and have also shown that still better results are produced by extending the bare fallow over the wet season as well (Le Roux and Stofberg, 1939).

The value of repeated ploughing, apart from any extra general drying out which may be produced, would appear to lie in the exposure of different layers of the soil to the sun. The powers of movement of the eelworm in the soil are very limited, and both active worms (larvae) and eggs would, no doubt, be killed very quickly to a depth dependent upon the penetration of heat and dry air. The effect of the actinic rays of the sun would presumably be confined more or less to nematodes and eggs exposed on the surface. Successive ploughings expose other layers of soil to the same treatment. Obviously, ploughing during the hottest and driest part of the dry season should produce the greatest effect, though the first ploughing should take place immediately after the crop is harvested.

The dry season in Southern Rhodesia is more intense and more prolonged than in most other agricultural countries, apart, of course, from arid areas under irrigation, and if the procedure indicated is useful anywhere, it should be useful in this Colony.

This method has its limitations. In the first place ploughing costs money, and the number of times that land can be ploughed economically in the dry season and without seriously injuring the texture, etc., of the soil is relatively small. In the second place, eelworm infestation is not confined to top 8 inches or so of soil, which it is safe to plough, so that measures aimed at reducing the eelworm population to a minimum in the ploughed layer can only be of a palliative nature.

The Tobacco Pest Suppression Act requires that all tobacco plants be removed from the land by August 1st in the case of Virginia tobacco, and by September 1st in the case of Turkish tobacco, and it also requires that re-growth be kept suppressed. The grower is advised to make a good job of this cleaning up process by taking the maximum practicable trouble to remove all tobacco roots, as far as possible, and to include the roots of any weeds growing in the land. The roots should be collected and burnt, although from the Hawaiian experiments it appears that exposure of plant roots to the sun on the surface of the soil for a few days will destroy all the contained nematodes. The land should

then be ploughed as soon as possible and such subsequent ploughings given during the dry season as may be practicable.

This advice refers to ordinary farm practice on land where eelworm infestation is light at the most. It should help to check increase of the pest.

Tobacco should always be rotated with immune or highly resistant crops. At least one of these crops should be of a nature which takes something approaching complete possession of the ground and suppresses weeds; *e.g.*, sunnhemp.

The usual rotation with tobacco in Southern Rhodesia includes maize for the third season. This has been regarded as a good practice, but doubt has now been thrown on this view, as already stated. It is, however, difficult to find a profitable alternative for this Colony. The most recent publication available (Tyler, 1941) includes only the following field cash crops in a tentative list of plants which appear most highly resistant, namely, oats, broomcorn millet (*Panicum miliaceum*), pearl millet (munga), rye and sorghum (kaffir corn). Teff grass is apparently highly resistant and suitable foı a rotation.

If maize is grown the cleanest possible cultivation should be practised, and after such a short season crop as sunnhemp has been turned in, the land will need attention to keep weeds suppressed on the still moist soil.

Land which is seriously infested with nematode requires more drastic measures to reduce the infestation, including bare fallow during the wet season. It is the general experience in other countries that bare fallow during the summer is more effective in reducing the eelworm population than either bare winter fallow or the growing of an approximately immune crop. The moisture in the soil and the high temperature tend to keep the nematodes active and they exhaust their vitality relatively quickly.

The measure, of course, involves throwing the land out of cultivation for one season and at the same time incurring the expense of keeping it clear of plant growth, and preferably ploughing it several times. However, the infested land is likely to remain useless for tobacco otherwise, so that some expenditure is justified with a view to reclaiming it for this crop.

In the experiments in the Union of South Africa labourers were sent through the fallow land to remove any weeds once a fortnight. This appears to be too much of an undertaking for the average farmer, although with normally clean tobacco lands weeding during the fallow period may not involve as much labour as appears at first sight. The weeds could, if necessary, be brought under control in the first place by discing. Whatever method is used, the land should be kept as free from weeds as it is practicable to keep it, and certainly no weeds should be allowed to grow for as long as a month, which is considered to be about the minimum length of time taken by the nematode to pass through a generation.

In Southern Rhodesia a bare fallow as above could conveniently extend from just after harvest in one year to the planting season in the year after, a period of about eighteen months.

According to the experiments in the Union of South Africa, this procedure only reduces the eelworm sufficiently to admit of one susceptible crop being grown on infested land, the nematodes increasing markedly during the first season under such a crop. However, a bare fallow and several ploughings during the following dry season may make it possible for a second crop to be grown. After this the land will presumably be planted to maize or other more or less resistant crop, and then to an immune soiling crop such as sunnhemp, before being returned to tobacco.

It is not possible to state that under Southern Rhodesian conditions this procedure will give all the results desired, but it represents the most hopeful lines along which to experiment.

This article would be incomplete without reference to the method of avoiding heavy attack in the early stages of the growth of tobacco plants, which was described by Mr. A. D. Collins, of Waterfall Estate, Tsungwesi, in this journal, June, 1938. Mr. Collins assumed that the top 2 inches of the ploughed soil was probably free from eelworm, due to the effect of the sun's rays. The ordinary check row chain was used for marking out the field, and the fertiliser was placed on the surface of the soil around each "knot" of the chain. A hill, apparently six inches high and 18 inches across, was built over the top of the fertiliser by scraping in soil from

the top two inches surrounding the position of the hill, and the tobacco was planted on the top of the hill. The plants had therefore about 8 inches of good surface soil, supposedly more or less free from eelworm, in which to grow before the roots reached the lower eelworm-infested layer. The growth thus obtained before the plants became attacked is believed to have given them sufficient resistance to the effects of infestation to enable a good crop to be produced. In any case, a profitable crop was reaped on land which was apparently badly infested.

The question as to whether the heating effect of the sun penetrates sufficiently to a depth of two inches in the soil to free this layer from eelworm requires investigation, but Mr. Collins' method is in general based on sound principles, and is worth a trial, if considered practicable by other planters.

Eelworm cannot be eradicated from cultivated lands, and control by means of chemicals is, under most conditions, uneconomic. The only practicable procedure appears therefore to be to attempt to control it, or to avoid the full effect of its presence, by cultural practices.

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Science and the Farmer.

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Farmers often complain about the growing difficulty of following the progress of agricultural science; the trouble is indeed not a new one, but science is becoming more and more highly specialised, and it is becoming ever harder for the farmer to understand what the scientist is trying to tell him.

Sometimes the trouble is a mere matter of words. For instance, when a writer on animal feeding speaks of *avitaminosis D*, he is using a term that any expert in the subject will understand, but which may convey no meaning whatever to a reader of normal intelligence and average education. Moreover the word is probably not in the dictionary, so that the reader must either give up the attempt to understand or else call in an interpreter. If the interpreter explains that avitaminosis D means "the group of symptoms produced through a deficiency of vitamin D in the animal's food" which again means, roughly speaking, rickets, then the point is reasonably clear.

Sometimes, again, the research worker is inclined to assume that we have all recently gone through the science side of a modern secondary school. A phrase like *the hydrogen-ion concentration of the soil solution* may probably have a clear and precise meaning to a schoolboy who has done a two-year course in chemistry, but must be meaningless to those of us who have had no time to follow the recent development of chemical theory. Moreover, if we translate into plain English we must be content with something like "the degree of sourness of the soil" which does not give the exact meaning.

Finally there are other instances where a scientific theory is quite beyond the comprehension of any but a specialist in the particular branch of science, and where the rest of us, if we try to grasp the argument, will achieve nothing but a headache. Here the scientist might reasonably be expected

to warn us off, and to content himself with pointing out the practical lesson, if any. We on our part must content ourselves with the thought that the proof of the pudding will be in the eating.

The writer has been asked to explain, in this series of notes so much as he understands (or hopes that he understands) about some of the more important of recent developments in the science of agriculture.

I. Soil Reaction and Lime.—Thirty years ago, when some of us were students, soil science was one of the more easily understandable branches of agricultural learning.

In those days the soil contained four simple and distinct kinds of matter. In an ordinary soil the bulk consisted of solid, stony particles differing one from another chiefly in size. They could readily be sorted out into their various size groups and these were called by ordinary names—stones, gravel, coarse sand, fine sand, silt and clay. The only other point was that, if the soil was to be fertile, some of the particles should be limestone or chalk rather than any other kind of stone.

The second component was the soil moisture which was, of course, not pure water but which contained, in ordinary solution, small amounts of nitrates, potash compounds and other salts. It also contained some carbonic acid and was thus able to dissolve, from the stony particles, substances that were insoluble in pure water. The plant obtained its food by drawing in this solution through its root hairs.

In a properly-drained soil the soil moisture was present only as a film on the surface of the soil particles, and for the rest the spaces between were filled with air. This air contained more carbon dioxide than the ordinary atmosphere, which fact accounted for the carbonic acid in the soil moisture.

The fourth soil component was humus, a dark brown or black substance produced by the decay, in the soil air, of dung, turf and other plant remains. Humus was spongy stuff and therefore, in a sandy soil, it was useful in helping to hold moisture. In a clay soil it was useful because it got in between the clay particles, kept them from sticking together and so made the mass more easily workable.

If, then, one wanted to make an enlarged model of a soil one made a mixture of glass marbles and beads of mixed sizes, added some chopped-up pieces of sponge, and moistened the whole with a weak solution of salt.

Regarded from the chemical point of view, one important point was that a soil might be alkaline ("sweet") or acid ("sour") or neutral (neither sweet nor sour). The reason was that humus was itself an acid, while lime was a base. If acid were allowed to accumulate, the number of kinds of plants that would grow in the soil would become fewer until at last only acid-loving plants, like heather, would grow at all. The way to prevent or to cure acidity was to add lime.

There were two simple tests by which one could get an idea of the sweetness or sourness of the soil. If some strong acid were poured upon it, and it fizzed, then lime (calcium carbonate) was present; if there was no fizzing there was no lime, and either the soil was already sour or might be expected soon to become sour. To find out whether sourness had already developed one shook up the soil with water, and the water was then tested with litmus. Acid turned blue litmus red.

The general idea was that the soil should not be acid and should preferably contain some lime (calcium carbonate)—possibly half of one per cent., or about five tons in an acre of top soil.

This old conception of the structure of the soil is not so very far from the truth if we happen to be dealing with a very sandy type; but it fails to account for the behaviour of a soil containing, as most do, a considerable amount of clay. Clay is known to consist of very small particles, but if one grinds up one's glass beads to a fine glass powder this fails to behave like clay; it does not swell up or get sticky when it is wetted, does not shrink or bind together as it dries, and gives up its water much more readily than clay does. Moreover, there is this further difference: clay has the interesting power of absorbing potash or ammonia from a solution, whereas such a solution passes unchanged through powdered glass. As regards the problem of sourness, it has been found that an ordinary soil may contain no calcium carbonate, may be acid in some degree, and yet may produce very well a wide range of crops.

Nowadays the physical behaviour of clay—its swelling and shrinking, its stickiness when it is wet and its setting hard when it is dried—are explained by saying that it, or some part of it, occurs in the soil as a *colloid*. If we put a grain of salt in water it dissolves and there is, at any stage, an obvious and clear-cut difference between the solid salt and the surrounding salt solution. But we must picture a colloid particle in water as having no such clear-cut surface. It shades off by degrees from a solid core to a liquid solution. It must be pictured not like a glass bead in water but rather as a gelatine particle that has been soaking in water for some time. To reconstruct our large-scale model of a soil we should thus have to add some gelatine powder to our mixture of marbles and beads.

The other essential point is that the clay particle is not chemically inert, like a grain of glass, but can combine, chemically, with hydrogen or alternatively with bases such as calcium (lime), potassium and ammonia. In other words, the clay particle, as well as the humus particle, behaves as what the chemist calls an acid radicle.

An acid radicle may be explained by reference to sulphuric acid and the sulphates. The radicle in this case is composed of sulphur and oxygen atoms and is represented by the symbol=SO_4. Its compound with hydrogen, H_2SO_4, is sulphuric acid. Calcium sulphate or gypsum ($CaSO_4$), copper sulphate ($CuSO_4$) and potassium sulphate (K_2SO_4) are familiar salts in which the hydrogen of the acid has been replaced in each case by a different base. Sulphuric is a strong acid. When it combines with a strong base like lime the resulting salt, calcium sulphate, forms a neutral solution; copper, on the other hand, is a rather weak base and hence a solution of copper sulphate has an acid reaction. Again there is a salt called potassium hydrogen sulphate ($KHSO_4$) which is half way between sulphuric acid and ordinary potassium sulphate. This salt again, as might be expected, gives an acid solution. Now the clay radicle behaves in the same general manner as the sulphate radicle, combining with hydrogen to form an acid hydrogen clay, or with a base, such as lime, to form calcium clay. It differs from the sulphate radicle in two respects. Firstly, it is a much larger

and more complex piece of matter, and can combine with more things at once; secondly, its acid is a weak acid, and therefore when it is fully combined with a strong base like lime the resulting calcium clay gives an alkaline reaction to the soil solution. A calcium-hydrogen clay does not necessarily give an acid reaction, but one which will be acid, alkaline or neutral according to the relative proportions of calcium and hydrogen which it contains. As calcium sulphate (gypsum) differs from sodium sulphate (Glauber's salt) so does a calcium clay differ from a sodium clay. The latter is an extremely sticky and impervious substance, and its formation accounts for the extraordinary change in a clay soil which has been some time under sea water.

A clay particle such as might occur in a fertile soil would contain potassium and ammonium as well as lime and hydrogen. This might give a slightly acid or slightly alkaline reaction according to the proportion between the hydrogen and the bases.

It will be evident that the reaction of a soil solution may vary from fairly strong acidity to fairly strong alkalinity. In wet climates the bases tend to be washed out, so that soils tend to become acid. In dry climates the bases tend to remain, and soils are generally alkaline.

In order to measure degrees of acidity or alkalinity chemists have devised a scale of hydrogen-ion concentration, called for short the pH scale. The figures run from zero to 14, the zero representing the highest conceivable degree of acidity and the other end the highest imaginable alkalinity. The figure 7, naturally, means neutral.

Chemists are still arguing the question of how acidity or alkalinity affects the plant, and why different plants should be affected in different ways. Meanwhile their scale is very useful because it enables us to measure acidity and to say, with very fair certainty, whether or not a particular soil is too acid or too alkaline to grow a particular crop. It should perhaps be pointed out that mild acidity, in the chemist's sense, does not mean "sourness" in the farmer's sense. "Sourness" may be said to begin at about pH. 5.5.

The hydrogen-ion concentration of a soil solution can be quickly determined, with sufficient accuracy for practical purposes, in the field. This is done by noting the change of colour which the soil solution brings about in certain coloured substances. These substances change colour, as litmus does, but at more precise points on the pH scale.

British soils vary in reaction from about pH 3.8 to pH 8, and each species of crop has a fairly definite "failure point"—a degree of acidity which it cannot bear. The exact "failure point" varies a little with other conditions--rainfall for instance; moreover it is rare to find a field which is uniformly sour. A patchy failure rather than a uniformly bad crop is what is generally seen when a mixed sample of the soil gives a reaction near to the failure point of the crop.

Morley Davies gives the following list of "failure points" for a number of common crops under West-Midland conditions:-

	pH.		pH.
Red Clover . . .	5.5	Swedes and Cabbage	4.9
Sugar-beet.....	5.3	Ryegrass	4.3
Barley	5.3	Oats..... .. .	4.2
Wheat	5.1	Potatoes	3.8

Looking at the matter from a slightly different angle, Hendrick and Moore give the following list of what may be called "safety ranges"—the range of soil reaction within which each crop may be expected to make completely satisfactory growth—so long, of course, as other conditions are suitable. It will be noted that, in certain cases, alkalinity as well as severe acidity might prevent fully satisfactory growth.

	pH.		pH.
Sugar-beet	6.0—7.5	Wheat	5.5—7.0
Peas	6.0—7.5	Turnips	5.2—6.5
Barley....	5.7—7.5	Oats.......	4.5—6.2
Red Clover	5.5—7.5	Potatoes	5.0—6.2
Wild White Clover	5.5—7.1	Swedes	4.8—6.0

Putting quite broadly the conclusions from these and other similar lists, we may say that a slight degree of acidity is not harmful but actually beneficial; that if we want to

grow the whole range of ordinary crops we should aim at keeping our soil reaction about pH 6; and that we may expect no trouble with any common crop (if we exclude lucerne) until parts of our fields fall below pH 5.5. At this stage we may expect patchy failures of red clover, barley and sugar-beet, but we shall still be able to grow good crops of oats, potatoes and grass-seeds mixtures, excluding red clover

Useful as is a knowledge of soil reaction it is unfortunately true that the pH figure, by itself, is no guide to the *quantity* of lime that will be necessary to restore a sour soil to fertile condition—to reduce its acidity say from pH 5 to pH 5.8. The pH value tells us *how acid* the soil colloid is, *i.e.*, how far our colloid is combined with lime and how far with hydrogen. It tells us nothing about the quantity of colloidal material which our lime will have to act upon. A ton of lime per acre might make the desired change in reaction in a sandy soil, whereas four or five tons might be necessary to produce the same change in a peaty clay. An experienced man, dealing with a soil type that he knows, may, from the pH figure alone, be able to make a fairly close estimate of the amount of lime that will be required; but this is all that can be claimed.

The quantity of lime that will be required to produce a desired change in the reaction of a given soil cannot, in fact, be precisely calculated at present. There is, perhaps naturally, a widespread impression that the figure which the chemist gives as the "lime requirement" of a soil indicates the amount of lime that is actually needed to correct the soil's sourness. But this is far from being true, and the figure should never be taken at its face value. The "lime requirement" of a soil is simply the amount of lime that the soil will absorb from a solution of calcium bicarbonate, under certain conditions. But what a soil can absorb and what it may economically be given, are two different things. The following, from a paper by Morley Davies, emphasises the point:—

"The 'lime requirement' on a red sandy soil of the Bridgnorth series, at pH 6, was 15 cwt. calcium carbonate per acre, while the corresponding figure for a peaty soil

proved to be 12 tons calcium carbonate per acre. It is interesting to note that *in neither case was lime necessary for crop growth.*"

The soil chemist, in considering his recommendation about the quantity of lime to be applied in a given instance, takes account of the pH value, of the amount of calcium already present in the soil and of the capacity of the soil to absorb calcium. A very exact calculation is not called for—indeed, there is good reason for applying something more than the soil immediately needs; lime is lost in drainage water and there is much to be said for giving a dose large enough to last for a rotation or perhaps longer. There is no particular harm in applying 2 tons an acre where 30 cwt. would satisfy the immediate need. There is, however, a good argument against applying five tons in such circumstances—the point being that the greater the store of lime in the soil the greater will be the loss by drainage. In one of the Harper Adams College trials, plots were dressed at 25, 50 and 100 cwt. per acre respectively and the average annual losses, for the following seven years, were respectively 1, 3, and 6 cwt. per acre.

Moreover, there are circumstances under which excessive liming does positive harm. On certain light soils in Yorkshire, for instance, a slight deficiency causes, as elsewhere, a failure of red clover, but a slight excess induces common scab in the potato crops. In this instance the minimum necessary amount of lime should be given immediately before the clover, and the potato crop should follow only after an interval of two or three years.

The practice of liming is many centuries old, and the continued use of lime is necessary on much of our farm land if this to be prevented from going back to moorland and heath. At one time and another vast unnecessary expense must have been incurred by unnecessarily heavy doses of lime. To-day there is much land which would benefit, and probably repay, the expense of a properly calculated dressing. The agricultural organisers in all counties have facilities for soil analysis, and it must generally be worth while to seek their advice in the matter.

II. The Food of the Plant.—Long before the day of agricultural science the farmer had discovered for himself that certain substances, applied to the soil, improved the growth of plants. Some of these—dung, wood ashes and leaf mould—were derived from plants; others, like bones and wool shoddy, came from animals; still others were minerals—for instance lime and marl. Various of the early agricultural writers tried to fit the known facts into some kind of theory of manuring, but with no real success.

It was only about a hundred years ago that chemists began to be able to identify the various chemical elements of which plants are composed; when this became possible it was a natural step to try to discover whence these elements came, and which of them were important in relation to the fertility of the soil.

The early notion had been that the plant fed upon organic matter—the dead remains of other plants and animals. This, of course, is true of certain kinds of plants—of mushrooms and other fungi. But, as far as concerns the ordinary green plant, Liebig, just a century ago, showed fairly conclusively that the bulk of its substance is derived not from the solid matter of the soil but from air and water. The commonest group of compounds in the plant—sugars, starch, cellulose (fibre), oils and fats—contain only the three elements carbon, hydrogen and oxygen. The first of these compounds to be formed in the plant is the simple sugar glucose or dextrose. This is manufactured in the green parts of the plant from carbon dioxide, taken in from the air, and water taken up by the roots. The sugar is quickly converted to starch.

The process seems to take place in two stages. In the first, the carbon dioxide and water are combined to produce formaldehyde (formalin), the surplus oxygen being returned to the air. In the second stage, which follows almost instantaneously, six molecules of formaldehyde are combined to form one molecule of glucose. The reactions are written:—

(1) CO_2 (carbon dioxide) + H_2O (water) = CH_2O (formaldehyde) + O_2 (oxygen).

(2) 6 CH_2O (formaldehyde) = $C_6H_{12}O_6$ (glucose).

This process can be repeated by the chemist in the laboratory—sugar can be made from air and water without bringing

in the plant; but, fortunately for our industry, the artificial process seems likely, for some time at least, to remain more expensive than the natural one.

In the plant, the glucose is easily converted into cane sugar (as in the sugar-beet), into starch (as in the potato), into oil (as in linseed) or into woody fibre (as in a timber tree).

Next commonest among plant compounds are the proteins which contain, besides the three elements of sugar, a substantial amount (about 16 per cent.) of nitrogen. Some proteins contain sulphur and phosphorus as well. The actual living matter of the plant—the protoplasm—has much the same gross composition as the proteins.

The source of the nitrogen in the plant was for long a matter of dispute, and the early experiments did not produce an answer. For instance, the earliest field trials with chilean nitrate, about 1840, showed that this stuff had an astonishing effect upon the growth of wheat, but no effect whatever on clover. Eventually, about fifty years ago, the main facts were established: some of the lower plants—the yeasts and certain kinds of bacteria—can make use of the free nitrogen of the air; the ordinary green plant cannot do so, but depends upon a supply of nitrogen compounds in the soil (nitrates and ammonia); exceptionally, beans, clovers and other leguminous plants are independent of nitrogen compounds in the soil, because they live in a kind of partnership with particular strains of nitrogen-fixing bacteria.

Leaving aside nitrogen, which is discussed in Part III. of this series, the remaining food materials of the plant are mineral salts taken up, in the soil solution, by the roots. When plant material is burnt, the bulk of these minerals remains as ash; the total amount of this ash is usually not large—perhaps five per cent., by weight, of the total dry matter. The list of elements in the plant ash is a very long one; some, like calcium (lime), magnesium and phosphorus, are abundant; others, like boron and copper, occur only in minute amounts. Among all these are only a few with which the farmer, in the ordinary way, is concerned, the point being that many of them occur, in ordinary soils, in more than

adequate amounts. The early experiments at Rothamsted distinguished quite clearly between those elements, like potassium and phosphorus, which are likely to be in short supply and those others, like sodium, magnesium and sulphur, which are usually present in abundance. Naturally, the position is not the same in all parts of the world. A few scattered instances have been found where soils contain too little sulphur for full plant growth, and there is some evidence in this country that fruit crops—especially raspberries—may suffer from a shortage of magnesium. But, broadly speaking, the results of the early Rothamsted trials apply to the world at large—the two mineral elements which most often require to be added to the soil, in order to keep it fertile, are potassium and phosphorus.

Lately, indeed, a great deal has been discovered about the "trace" or "minor" elements, which are required by the plant only in minute amounts, but which the soil may nevertheless fail to provide in sufficient quantities. Cases of zinc and copper deficiencies have been found. In parts of this country two of these trace elements, boron and manganese, are of real importance. Boron deficiency, for instance, is the cause of crown-rot in sugar-beet and of brown-heart or "raan" in swedes; manganese deficiency can be the cause of crop failures, more especially with oats and most frequently on land that has been heavily limed. With such soils a dressing of a few pounds per acre of borax, or of manganese sulphate, will generally put matters right.

In other soils the deficiency of a minor element shows not in the plant but in the animal which feeds upon the plant. Thus within the last two years it has been shown that "swayback" in lambs is caused by a deficiency of copper in the herbage upon which the pregnant ewe has been fed, and that a pining disease of sheep, common in parts of the Cheviots, is due to the failure of the pastures to provide the necessary trace of cobalt. Here again the remedy, once the nature of the trouble has been discovered, is usually cheap and easy.

The important mineral fertilisers are those supplying potassium and phosphorus.

Potash.—The exact function of potash in the plant is not understood, but it is in some way connected with the efficiency of the process of starch formation in the leaf. Potash deficiency often shows itself in the form of "leaf-scorch" in which the tips and edges of the leaves turn brown and die. Potash occurs in most ordinary rocks, in the form of such minerals as felspars and micas; in soils formed from such rocks—for example boulder clays derived from granite—the total amount of potash may amount to many tons per acre The potash in these minerals is, however, insoluble and unavailable, and is set free only slowly as the minerals are weathered.

The simple salts of potash which are used as fertilisers (the sulphate, muriate or chloride and the nitrate) are all very soluble in water and therefore no question arises of any difference in their availability to the plant. Some of our potash fertilisers (sulphate of potash and muriate of potash) are practically pure salts, and here any difference in their action depends upon the acid radicle (sulphate of chloride) with which the potash is combined. The chloride may be harmful to certain crops (potatoes and fruit) if large applications are made. Others of the potash fertilisers are impure, the bulk of the impurity being common salt. The salt may be useful, as sometimes with mangolds, sugar-beet, barley and grass; or harmful, as it is to potatoes. But always where we apply an ordinary potash fertiliser, we are adding a water-soluble salt, and the effect upon the potash status of the soil will be substantially the same.

The fate of potash applied to the soil is not what might be expected. If, for instance, we apply the chloride, and the soil is washed with rain water, the chlorine passes out in the drainage water, while the potash combines with the clay of the soil and pushes out other bases. This is clearly shown by the Aberdeen experiments with drain gauges, which are enclosed blocks of soil from which the whole of the drainage water can be collected. In one such experiment one block of soil was left unmanured while the other had, over a period of years, applications of muriate of potash amounting to about five hundredweight per acre. The results were:—

	Unmanured.	Muriate of Potash.	Difference
Chlorine (lb. per acre):			
Applied	0	273	273
Found in drainage water	41	317	276
Potash (lb. per acre):			
Applied	0	272	272
Found in drainage water	10	13	3
Other Bases (lb. per acre):			
Found in drainage water:			
Lime	167	345	178
Magnesia...	41	81	43
Soda	102	152	50
Total	310	581	271

The conclusion is thus that, of 272 lb. of potash applied to the soil, only 3 lb. was washed out; for the rest the effect of the potash was to push out of the soil, and into the drainage water, 271 lb. of the other bases—lime, magnesia and soda.

This is an example of *base exchange*; the principle is that which is used in the common permutite process of water softening, where the lime salts are taken out of the water by a soda compound; when the latter has given up its soda and is full of lime, it is drenched with common salt, and the limey water which comes off is run to waste.

There is no doubt that the retention of potash by the soil depends upon the action of the colloidal clay, but even an ordinarily sandy soil contains enough clay to prevent any serious loss. This is all to the good. But it must be remembered that the tenacity with which potash is held by the soil is a disadvantage under certain conditions. For instance, if we give a top dressing of sulphate of potash to an apple orchard on clay soil, it will be a matter of years before the potash is washed down into the soil zone where the feeding roots of the trees are situated. In such circumstances it may be an advantage to plough in the dressing. There is also some evidence that the ploughing-in of potash is an advantage with the deeper-rooting annual crops, such as sugar-beet. It also seems that, under certain conditions, part of the potash

that we apply may be so firmly held that the plant is not able to extract it from the soil. It is however with phosphates, and not with potash, that this problem of conversion from an available to a non-available form is of practical importance.

Phosphates.—The ordinary phosphatic fertilisers are phosphates of lime. The acid lime phosphate that is produced by treating ordinary mineral phosphate with sulphuric acid (superphosphate) is soluble in water. In certain other manures—bone meal, bone flour, and "high-soluble" basic slags—the phosphate is insoluble in water but fairly soluble in dilute weak acid. One-per-cent. citric acid is used in testing. Still other forms, like the "low-soluble" slags and ground mineral phosphate, are only slightly soluble in weak acid.

Even a water-soluble phosphate is not lost, by drainage, from an ordinary soil. There may indeed be loss from a very shallow stony soil upon a steep slope, but the likelihood here is that the phosphate is washed away as small solid particles in running water, rather than in solution by drainage. In the Aberdeen drain-gauge experiments the unmanured block lost, in the drainage water, only a fraction of a pound of phosphoric acid per acre per year, and the application of half a ton of superphosphate, over a period of years, did not increase this loss. Indeed the problem of phosphatic manuring is that the soil tends to take up phosphate and hold it so firmly that the plant roots are unable to extract it. Were this not so, we could farm with much lower applications of phosphate than those which we commonly use. A single hundredweight of superphosphate contains as much phosphoric acid as is removed from the soil by an ordinary crop of wheat or swedes, and considerably more than that removed by an average crop of hay. Actually there are parts of the world where very light dressings are quite as effective as could be expected. In parts of Australia and Africa remarkable responses, both with pasture and with arable crops, can be obtained from applications of half a hundredweight of superphosphate per acre. In this country, on the other hand, really deficient soils may give little or no response to applications of less than five or six hundredweight, and half a ton is necessary under some conditions.

Professor Hanley has investigated the position in connection with the famous Tree Field experiment at Cockle Park. Plot 4 of the trial has had an application of 5 cwt. of basic slag per acre every third year during the last forty, or a total of 65 cwt. per acre. Of this amount only about 5 cwt. can be accounted for in the bones of the sheep that have been fed and grown upon the plot. About 59 cwt. of the slag, or at least of the phosphate which it contained, is still lying in the top nine inches of soil; and yet the plot continues to respond to fresh applications. The appetite of the soil for phosphate seems to be insatiable.

This problem was rather fully discussed by F. Hanley in the May number of this Journal, and it seems unnecessary to cover the ground again. The main points are:—

(1) In lime-deficient soils, water-soluble phosphate is liable to combine with iron and alumina, giving very insoluble and therefore unavailable compounds. At the other extreme, on very chalky soils, the compounds that are formed also tend to be rather highly insoluble; the fullest utilisation of superphosphate is obtained on soils with a moderate lime content.

(2) The least soluble phosphatic fertilisers (ground mineral phosphate and low-soluble slag) give very poor results on neutral or alkaline soils. On rather acid land they may produce nearly as good responses as high-soluble slags.

(3) Where the soil has a strong tendency to fix phosphate in a non-available form, there is an argument, in theory at least against mixing the phosphate intimately with the soil. If we drill the fertiliser in narrow bands, and bury it some distance below the surface, we may succeed in eliminating, to some extent, the competition for phosphate between the soil and the plant.

Testing Soil for available Potash and Phosphate.—The same kind of process that is applied to a basic slag—the measurement of its solubility in weak acid—may be applied to the soil. The result obtained is expressed by the chemist as "available phosphate" or "available potash" as the case may

be. Besides such methods of chemical analysis, there are various biological tests, in which the chemist seeks the assistance of a growing plant in his endeavour to estimate the amounts of available nutrients in the soil.

An example of the latter is the Neubauer seedling method. In this, a sample of the soil is mixed with a fixed proportion of sand, and rye is sown in a pot of the mixture. The seedlings are allowed to grow, in a greenhouse at a carefully regulated temperature, for 17 days. On the eighteenth day the rye shoots are removed and are analysed for potash and phosphate. It is known that a properly nourished plant of rye, at this stage of growth, contains certain percentages of potash and phosphate, and the basis of the test is the assumption that any deficiency of either, in the soil, will be reflected in the composition of the plant.

It would be very helpful to the farmer if a quick and cheap test of this sort could tell him how to manure a particular crop on a particular field. Unfortunately it seems that no one of the known methods can give the information that is required. Every method is liable, at times, to lead to conclusions that are contradicted by actual experiments in the field. The figures arrived at in the laboratory can never be taken at their simple face value, but require to be interpreted by someone who knows the behaviour of the particular type of soil and of the particular crop that it is proposed to grow. On the latter point alone we know, for instance, that certain forms of soil phosphate that are available to a swede plant may be unavailable to the potato; on phosphate-deficient land swedes will generally respond to either ground mineral phosphate or to superphosphate, whereas potatoes will benefit from the latter but not from the former.

Doubtless, in time, we shall get to the position when we shall be able to base our use of fertilisers on laboratory tests of our soils. But that stage has not yet been reached.

III. Nitrogen.—The chemistry of nitrogen is a very difficult and involved subject that is, as yet, far from being fully understood. The nitrogen supply of the plant is, however, a matter of prime importance in crop production, and,

as is well known, the amount and the nature of the soil organic matter (humus) is important from other points of view apart from its value as a source of nitrogen.

The forms in which nitrogen occurs in nature are almost numberless, but, from the farmer's point of view, they may be roughly placed in five groups.

First is the element itself, which is a gas and constitutes nearly four-fifths, by volume, of the air. The total amount of nitrogen in the air runs to many thousands of tons per acre of land surface, so that there is an inexhaustible supply of the raw material out of which nitrogen compounds can be made. Nitrogen is, however, a very inert gas, *i.e.*, it can be made into compounds with other elements only with great difficulty and with the expenditure of a great deal of energy.

Secondly we have simple and so-called "inorganic" compounds, of which the most important are nitric acid (HNO_3) with its salts (nitrates), and ammonia (NH_3) with its salts, such as sulphate of ammonia. It is a peculiar fact that the one compound is a strong acid and the other a strong base, so that if ammonia gas is bubbled through nitric acid the two unite to form ammonium nitrate (NH_4NO_3).

Thirdly we get the group of organic compounds which are built up by the plant, and which provide the nitrogenous food of animals. The simpler of these are called amino acids, and the more complex, built up of a number of amino acids, are known as proteins. Intermediate between these substances and the inorganic group is urea, which is the commonest form in which waste nitrogen is passed out of the animal through the kidneys. Urea is a compound of carbon, oxygen, hydrogen and nitrogen $CO(NH_2)_2$ and readily combines with water to form ammonium carbonate (smelling salts) $(NH_4)_2CO_3$. This is an unstable substance which readily gives off ammonia into the air, and its breakdown explains the smell of ammonia that is given off by stale urine.

Fourthly is the actual living substance of plants and animals (protoplasm), which is a watery jelly of immensely complex composition. The dead, dry matter of protoplasm contains about a sixth part of nitrogen.

Lastly are the remains of plant and animal substances which have been subjected to putrefaction and decay—the soil humus, peat and coal. The common feature of these substances is that they contain much less nitrogen than proteins, and give up what they have very much less easily.

Only a few plants can make use of the free nitrogen of the air or, on the other hand, feed directly upon the organic compounds. The majority must take nitrogen compounds from the soil, and the only forms that can pass through the membrane of the root hair are the simple inorganic substances—nitrates and ammonia.

A certain amount of the nitrogen of the air is brought into combination by natural processes unconnected with life. At the high temperature of a flash of lightning nitrogen combines with oxygen to give an oxide, and this, dissolved in rain, makes nitric acid. The farmer thus gets a free annual top dressing of nitrogen and it is this that partly accounts for the fact that a piece of unmanured land, like the plot on Broadbalk field at Rothamsted, will continue to produce a wheat crop of sorts for an indefinite period of years. But the amount of nitrogen so obtained is far short of the farmer's requirements.

Fifty years ago the supply of nitrates and ammonia for purposes of soil fertilisation was becoming a matter for anxiety; the Chilean nitrate beds were obviously not inexhaustible, and the output of sulphate of ammonia from gas works, etc., could not be materially increased. The situation has, of course, been met by the invention of chemical processes for "fixing" the nitrogen of the air. Nitrate of lime is produced by a process that imitates the action of lightning; ammonia is made by mixing nitrogen and hydrogen and passing the mixture over what is called a catalyst at a high temperature and under enormous pressure. Both these processes involve a great input of energy, which is obtained either from water power or from coal. Nevertheless, they have provided the farmer with unlimited supplies of nitrogen fertilisers at comparatively low prices. It may be recalled that, in 1913, the price of sulphate of ammonia was about £14 per ton, or nearly twice the present figure (1939).

The behaviour of nitrates and ammonium salts, when these are applied to the soil, is not hard to understand. Nitrate, like any other soluble acid radicle, remains in the soil solution and forms no compound with the clay fraction. If water is percolating down to the drains it carries the nitrate with it. Losses are therefore inevitable whenever drainage water escapes. Moreover, the loss is not avoided if drainage is prevented, for under water-logged conditions certain soil bacteria destroy the nitrate in order to get the oxygen which it contains, and free nitrogen goes back to the air. Hence, as is well known to farmers, nitrates are best applied as top dressings after the crop has been established, and when there is a network of roots waiting to absorb it. Only in the drier districts, and at the drier seasons of the year, is it safe to apply nitrate at seed time.

Ammonia, as such, is very firmly held by the soil; it behaves in the same way as potash, uniting with the clay radicle. Unfortunately, if the soil is warm and well aerated, ammonia does not persist, but is oxidised by the nitrifying bacteria, giving nitric acid and water:—$NH_3+2O_2=HNO_3+H_2O$. Under ordinary summer warmth, and with a moist soil, this change is carried through in a matter of days; on the other hand sulphate of ammonia will remain for a long time in the top layer of a dry soil, and no effect will be seen until there is a shower. Nitrate, on the other hand, absorbs moisture readily from the air, and often penetrates the soil without the help of rain. In nitro-chalk, the nitrogen is combined as ammonium nitrate and therefore this fertiliser is intermediate, in its rate of action, between sulphate of ammonia and nitrate of soda or nitrate of lime.

A secondary effect of sulphate of ammonia upon the soil, and one that is important in certain circumstances, is that its use increases the loss from the soil of lime and other bases. In itself it is a neutral substance (neither acid nor basic) but the change which the ammonia undergoes converts it, in effect, into a mixture of nitric and sulphuric acid, both of which combine with, and use up, the bases of the soil. The Aberdeen drainage investigations show this clearly. One drain gauge, of uncropped soil, was left unmanured, while another, over a period of years, had sulphate of ammonia to the amount of nearly six cwt. per acre.

The figures (in lb. per acre) were:—

	No Manure.	Sulphate of Ammonia.	Difference.
Nitrogen applied as sulphate of ammonia	0	119	119
Nitrogen in Drainage Water:			
as ammonia	1	1	—
as nitrate...	122	245	123
Bases in Drainage Water:			
Lime	167	415	—
Magnesia	41	200	—
Soda	102	136	—
Total Bases	310	751	441

Thus the whole of the nitrogen applied as ammonia appeared in the drainage water as nitrate, and the six cwt. of sulphate of ammonia applied led to a loss of nearly four cwt. of bases.

Despite this disadvantage, it may easily happen that, all things considered, sulphate of ammonia is the best nitrogen fertiliser for the particular purpose that we have in mind. Its effect upon the lime status of the soil must not, however, be forgotten. In some of the Woburn experiments, for instance, its continued use has produced so extreme a degree of soil acidity that the land now grows practically nothing but spurrey.

The rapidity of action of artificial nitrogen fertilisers, as compared with organic manures, may be either an advantage or a disadvantage. Where a plant absorbs food over a period of many months it must be obvious that a single large dose of nitrate or ammonia will provide a temporary superabundance of nitrogen, with the risk of a scarcity later on. With wheat, for instance, an early spring top-dressing, alone, may be perfectly sound if the land has a good reserve of organic manure, which will continue to yield up nitrate throughout the summer. On the other hand, if the land is deficient in organic residues, a heavy spring top-dressing will produce a heavy growth of straw, but will not last out until the time of grain formation. In such circumstances it is an advantage to give the crop two "feeds"—one early and the other later (perhaps in May), after the ears have begun to form.

Rhodesian Milk Records.

SEMI-OFFICIAL. COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B. Fat in lbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Lady	G. Friesland	4873 80	203.06	4 17	267	
Princess	G. Friesland	4711.00	217 47	4.62	232	N. G. Barrett, Gavenny, Rusape.
Billie Boy II.	G. Friesland	7718.20	225.10	2.92	234	
Chimite	G. Friesland	10144.20	383.46	3.78	300	J. A. Baxter, Glen Norah, P O. Box 1368, Salisbury.
David	G. Friesland	10542.10	408.63	3.87	300	
Delphine	G. Friesland	8241 80	333.89	4.05	300	
Freda	G. Friesland	7696.40	283.33	3.68	300	
Gort	G. Friesland	6889 00	262.58	3.81	300	
Kits	G. Friesland	7634 30	310.48	4.07	300	
Lep	G. Friesland	5242.50	211.27	4.03	222	
Leslie	G. Friesland	6919 10	277.67	4.01	262	
Mangese	G. Friesland	5791 70	291.05	5.02	300	
Norton	G. Friesland	5868.60	208.86	3.56	300	
Paris	G. Friesland	6702.30	259.10	3.87	281	
Sandy	G. Friesland	8788.10	342 05	3.90	300	
Zuru	G. Friesland	7076.80	277.10	3.92	275	
Ina	G. Friesland	6068.20	248.51	4.10	300	J R Bedford, Poltimore, Marandellas
Madge	G. Friesland	6784.70	264.14	3.90	300	
Ticky	G. Shorthorn	4662 90	211 23	4.53	300	
No. J. 2	G. Friesland	5739.40	201.23	3.51	229	
No. J. 8	G. Friesland	6483.70	268.62	4.14	300	A. L Bickle, P.O. Box 595, Bulawayo.
No. J.12	G. Friesland	10735.50	340.13	3 17	300	
No. J.13	G. Friesland	10081.40	353 59	3.51	300	
No. J.17	G. Friesland	7108.80	215 58	3.03	257	
No. J.18	G. Friesland	7708 00	284.41	3 69	272	
No. J.19	G. Friesland	8440.30	284.01	3.36	202	
No. J.20	G. Friesland	10529 50	353.31	3.36	300	
No. J.21	G. Friesland	7148.80	255 34	3.57	300	
No. J.26	G. Friesland	8226.70	337 13	4.10	300	
No. J.29	G. Friesland	9401 60	326 45	3.47	300	
No. J.31	G. Friesland	7739.70	270 25	3.49	300	
No. J.32	G. Friesland	6987.20	225 43	3 23	276	
No. J.41	G. Friesland	6624.10	228.48	3 45	300	
No. J.48	G Friesland	7698.80	319.72	4 15	100	
No J.49	G Friesland	9096 20	322.23	3.54	300	
No. J.50	G Friesland	9120 90	284.58	3.12	300	
No. J.53	G Friesland	7730.30	268.37	3.47	287	

No. J.59	G. Friesland	7203 30	297 80	4.13	300	A. L. Bickle, P.O. Box 595, Bulawayo.
No. J.63	G. Friesland	8347 70	274 04	3.28	300	
No. J.66	G Friesland	5303.80	236 65	3.90	266	
No. 10	G. Friesland	7093 00	237.11	3.34	286	
No. 37	G. Friesland	6849.10	233.18	3.40	268	
No. 55	G Friesland	6022 90	248 88	4.13	282	
No. 60	G Friesland	8821 10	297 32	3 37	300	
No. 62	G. Friesland	7033 50	239 41	4.11	266	
No. 70	G Friesland	6409 30	220 78	3 44	266	
Avondale Ruth	P B. Friesland	8999.10	285 59	3.17	300	Bluffhill Dairy, P.O. Box 346, Salisbury
Palm Tree Witty	P B Friesland	7651 50	250.10	3 27	289	
No. 23	G Friesland	7296.30	282.08	3 87	300	
No 48	G Friesland	6103 80	205 19	3.36	300	
No. 50	G. Friesland	5807 30	200 44	3 45	300	
No 55	G Friesland	8014 00	301 67	3 76	300	
No 88	G. Friesland	7281 40	259 36	3 56	300	
Bessie Bones	G Friesland	6461 00	250.78	3.88	300	Boyd Clark Est, Castle Zonga, Inyazura
Beauty III	G. Friesland	5346.00	204 21	3.82	300	
Black and White II.	G Friesland	6267 50	235 68	3.76	300	
Brandy I.	G Friesland	5554 50	211 24	3 80	205	
Daisy	G Friesland	6322 00	236 21	3 74	300	
Makaza	G. Friesland	6244 50	231 08	3.70	300	
Makaza II.	G. Friesland	7738 00	259.65	3 36	300	
Spot II.	G. Friesland	6830 50	284 46	4 17	300	
Spot III.	G Friesland	6343 00	245 49	3.87	300	
Truant	G. Friesland	7174 00	276 59	3 86	279	
Zoe I.	G Friesland	6052 00	233 15	3.85	300	
Zoe II.	G. Friesland	6031.00	224 46	3 72	299	
Beryl	G. Friesland	6414.30	213 55	3 33	285	E W. Brighten, Castle Base, Rusape.
Bluebell	G. Friesland	4791.40	205 19	4 28	291	
Bunty	G Friesland	7627 30	260 51	3 42	300	
Cora	G Friesland	5377 70	227 14	4 22	300	
Queenie	G Friesland	6825 20	237 80	3.48	300	
Bloom	G Red Poll	5669 50	235 68	4 16	271	K. M Campbell, Hedon Farm, Marandellas
Bluebell	G. Friesland	6552 50	263.54	4 00	300	
Constance	G Friesland	7192 60	272 49	3 79	300	
Pinkie	G Red Poll	6185 50	254 73	4 12	272	
Snotty	G Friesland	6874 50	258 00	3 75	300	
Tiny	G Friesland	6948 50	264 04	3 80	285	
No. 236	G Friesland	6269 50	222 48	3 55	300	Coldstream Dairy, P.O. Headlands
No. 261	G Friesland	5654 00	204 91	3.62	300	
No. 281	G Friesland	7837 00	252 07	3 22	267	
No. 287	G Friesland	7429 00	293 94	3 96	300	
No 309	G Friesland	5244 50	237 18	4.52	300	
No. 316	G. Friesland	5775 00	227.77	3 94	300	
No 319	G Friesland	6063 00	213.97	3 53	275	
No. 326	G. Friesland	6031.00	213.25	3.54	300	

RHODESIAN MILK RECORDS.

SEMI-OFFICIAL.—(Continued).

Name of Cow.	Breed.	Milk in lbs.	B Fat in lbs.	Average % B. Fat	No. of Days.	Name and Address of Owner.
Chibi	G Friesland	4314.00	206 35	4.78	287	T. Cousins, Oaklands, Gwelo.
Dimity I.	G. Friesland	7524.70	237.83	3.16	246	
Dolly	G Friesland	7601.80	262 93	3.46	300	
Glass	G. Friesland	5448.70	223.44	4.10	197	
Inyouti	G. Friesland	6609.30	268.92	4.07	233	
Patricia	G. Friesland	10431.20	401.11	3.85	300	
Phoebe	G. Friesland	6856 40	234 50	3.42	300	
Prune	G Friesland	5431 00	204.05	3.76	271	
White	G. Friesland	5137.60	212.49	4.14	251	
Winnie	G. Friesland	7658.20	255.76	3.34	300	
No. 3	G Friesland	6592.20	238.62	3.62	300	H A. Day, Stoneridge, P O. Box 1153, Salisbury.
No. A.30	G. Friesland	6061 70	204.22	3 37	273	
No. A.49	G. Friesland	7290.60	224.28	3.08	300	
Mafunga	G. Friesland	5479.00	225 96	4 12	300	A C. de Olano, Blue Waters, Bromley.
Blackie	G. Friesland	8959 90	285.92	3.19	300	D. J. Huddy, Granville, P.O. Box 899, Salisbury.
Mary	G Friesland	6878.10	245.99	3.58	273	
Woodlands	G Friesland	6625 90	221.09	3.34	300	
Cataquara	G. Friesland	5888.30	228 58	3.88	300	Mrs M Huxham, Spitzkop, Mazoe.
Darling	G. Friesland	5105 80	208.83	4.09	300	
Pumpkin	G. Friesland	5401.00	206.79	3.83	300	
Vaaltuin	G. Friesland	5924.70	261.80	4 42	300	
Armoed	G. Friesland	8775.50	257.31	2 93	300	V. A. Lawrence, Knockmaroon, Norton
Buttercup	G. Friesland	6764.00	251.99	3.73	248	
Ellaglen	G. Friesland	9987.50	289.40	2 90	300	
Honey	G. Friesland	8066.00	239.71	2.97	300	
Larkhill Primula	G. Red Poll	4123 90	221.13	5.36	284	A. H. MacIlwaine, Larkhill, Marandellas.
Larkhill Wilfull	G. Red Poll	5602.60	236.93	4 23	300	
Etta	G. Friesland	5525 50	202 75	3 67	239	F. H R. Maunsell, Forres, Bromley.
Hazel	G. Jersey	4643.00	270.38	5 82	300	
Star	P.B. Friesland	8812 00	325.39	3 69	300	
No 42	G. Friesland	5786.00	201 59	3.48	286	Mazoe Citrus Est., P.O. Mazoe.
No. 43	G. Friesland	6414.50	218.58	3 41	279	
No. 7/7	P B. Friesland	8392.00	325 07	3.87	300	Meikle Bros, Leachdale, Shangani.
No. 187	P.B. Friesland	7378.00	233.78	3 17	300	
No. 275	P B Friesland	6689.00	250 54	3.75	239	
No. 10/7	G. Friesland	6821 00	237.05	3.48	263	
No. 13/7	G. Friesland	8356 00	304 90	3.65	264	
No. 93	G. Friesland	9290.00	326.42	3.51	246	
No. 132	G. Friesland	11516.00	404 82	3 52	300	

Betty	G. Friesland	5459.90	203.50	3.73	267	S Moore, Nyatsime, P.O Box 999, Salisbury.
Bud	G. Friesland	4975.30	213.91	4.30	251	
Blom	G. Red Lincoln	5603.50	243.70	4.35	300	G R Morris, P O. Box 1040, Salisbury
Gracie	G. Guernsey	4117.00	200 94	4 88	300	
Zia	G. Friesland	7245.00	248.22	3 43	300	F. R Morrisby, Sunnyside, Gwelo.
No. 18	G. Friesland	7140 00	258.87	3.63	300	
Daffodil	G Friesland	7281.10	281 78	3 87	300	W M Nash, Chakadenga, Marandellas
Philippa	G. Friesland	5156 10	218.98	4.25	300	
Fanny	G Friesland	7875 00	238 62	3.03	300	F Neill, P O Box 455, Salisbury
Mayo	G Friesland	9106 00	286.28	3 14	284	
Chenzira	G Friesland	7849.30	332.38	4.23	287	Red Valley Est, Lushington, Marandellas
Waringen II.	G Friesland	7076 30	279 43	3 95	290	
Witblom	G Friesland	5710 70	255 41	4.47	293	
Paradise	G. Friesland	7960 10	267 65	3 35	300	Red Valley Est, "P" Herd, Lushington, Marandellas
Pastry	G. Friesland	5883 00	251.12	4.27	273	
Patsy Pike	G Friesland	6404 20	234 38	3.66	300	
Peace	G. Friesland	6530 90	227 28	3 48	300	
Putney	G. Friesland	4997 50	213.19	4 44	259	
Pyjamas	G Friesland	7715 20	296 43	3.84	300	
Jane	G Friesland	6419 30	248.07	3 86	227	W F H Scutt, Maple Leaf, Norton
Gustom	G. Friesland	10179 10	299.92	2.95	300	
Zelesa	G. Friesland	6616 30	227.70	3 44	257	
Whinburn Ilex	App Friesland	6346.20	208 64	3 29	300	R R Sharp, Whinburn, Redbank
Annie	G Friesland	8625 10	315 76	3 66	300	W Sole, Bauhinia, Glendale
Bunty	G Friesland	11105 10	339 74	3 06	300	
Emma	G Friesland	8975.20	375.19	4 18	283	
Blue Bell	G. Friesland	7583 40	319 32	4 21	300	A Stokes, Safago, Gwelo
No. 193	G Friesland	8480 90	296 65	3 50	300	
No. 197	G. Friesland	8337 30	275.74	3 31	267	
No. 203	G Friesland	6936.20	260 41	3 75	287	
No. 227	G. Friesland	6685.70	265 25	3.97	249	
No. 259	G. Friesland	7080 20	213 29	3.01	296	
No. 264	G Friesland	5735 40	203 97	3 56	300	
Beira	G Red Poll	5027 50	215.92	4 29	300	J G Thurlow, Atherstone, Bindura
Byanby	G. Red Poll	5986 90	260.50	4 35	300	
Chin Mine	G. Friesland	5339 00	223 50	4 19	284	
Betty	G Friesland	6617 00	284 95	4 31	269	W E. Tongue, North Lynn, P O Box 199, Bulawayo
Dimple	G Friesland	8055 00	258 13	3 20	271	
Jane	G. Friesland	10630 00	333.47	3 14	263	
Kelpie	G Friesland	8302 00	281 63	3 39	247	
Mary	G. Friesland	6510 00	246 84	3 79	300	
Yvette	G. Friesland	10496 00	383.60	3.65	293	
Dirko Winter	P B. Friesland	6649.00	222 47	3 35	300	Union & Rhod. Mining & Finance Co., Ltd., Quinnington, Box 80, Salisbury
Pansy	G. Friesland	5657.00	218.58	3 86	300	

SEMI-OFFICIAL.—(Continued).

Name of Cow.	Breed	Milk in lbs.	B. Fat in lbs.	Average % B. Fat.	No. of Days	Name and Address of Owner.
Apple	G. Friesland	7204.90	330.32	4.58	239	J A Baxter, Glen Norah, P.O. Box 1368, Salisbury.
Bella	G. Friesland	7965.50	329.95	4.14	281	
Bulawayo	G. Friesland	13556.70	494.47	3.65	300	
Clacupar Pioneer	P.B. Friesland	7469 30	263 66	3.53	268	
Corina	G. Friesland	7980.20	262 69	3.29	300	
Happy Days	G. Friesland	8418.15	271.87	3 23	300	
Mbandi	G. Friesland	7192 10	244.39	3 40	300	
Monday	G Friesland	7256.20	270.77	3.73	300	
Nellie	G. Friesland	6972 15	266.87	3.83	300	
Nurse	G. Friesland	7758.80	319.80	4.12	300	
Paraffin	G. Friesland	6734 75	244 21	3.63	300	
Reynaud	G. Friesland	8006.70	263.61	3.29	300	
Sheep	G Friesland	6769.40	265 07	3.92	276	
White II.	G. Friesland	9669.94	372 21	3.85	300	
Willesden	G. Friesland	7131 63	259.54	3.64	265	
Hurali	G Friesland	8049.20	322.52	4 01	291	S. Moore, Nyatsime, P.O Box 999, Salisbury
Jess I.	G. Hereford	5296.80	281 54	5.32	300	
Mary	G Friesland	5125 20	238.91	4.66	300	
Motor Car	G. Shorthorn	4029.80	207 64	5.15	277	
Pearl	G. Hereford	4279 30	206.62	4.83	284	
Pim	G. Friesland	4879 90	224 88	4 61	273	
Sceptre	G. Hereford	4926 80	216.16	4 39	287	
Joan	G. Friesland	4315 00	202 67	4.70	300	Com E L Morant, Marirangwe, P.O. Box 741, Salisbury.
Joseph	G Lincoln Red Shorthorn	5290.00	240 41	4 54	300	G R. Morris, The Rest, P.O Box 1040, Salisbury.
Rice	G Lincoln Red Shorthorn	6209.50	257.21	4 41	300	
Nyama	G. Friesland	6104.80	262.26	4 30	284	J G. Thurlow, Atherstone, Bindura.
Bindura	G. Friesland	5408 20	224.16	4.14	260	
Marikop	G. Red Poll x Guernsey	5906.80	203 46	3 44	281	
Trixie	G. Friesland	9648 50	344 11	3.57	300	W Sole, Bauhinia, Glendale
Hilary	G. Friesland	6677 50	233 90	3 50	300	
Chisunda	G. Friesland	5560.20	232.61	4.18	300	W. F. H. Scutt, Maple Leaf, Norton.
Lomans	G. Friesland	10234 70	336.13	3 29	300	
Sonile	G. Friesland	6371 40	266.66	4 19	264	
Darwin	G. Friesland	4578.80	222 71	4.86	247	
No. 41	G. Friesland	6983 50	228 87	3.28	300	Mazoe Citrus Estate
No. 45	G. Friesland	7105.00	239 06	3 36	300	
Elsie	G. Friesland	6966.50	257 82	3.70	300	V A. Lawrence, Knockmaroon, Norton
Iris	G Friesland	5991 50	246.50	4.12	300	
Jebice	G Friesland	7240 50	315 26	4.35	300	M. Huxham, Spitskop, Mazoe.

No. 101	G. Friesland	8294.10	292.72	3.53	300	H. A Day, Box 1153, Salisbury.
No. A40	G. Friesland	6296.70	209.49	3.33	274	
No. A48	G. Friesland	8689.10	280.42	3.23	300	
No. 45	G. Friesland	5907.10	206.17	3.49	279	
No. A45	G. Friesland	5872.30	217.06	3.69	300	
No. 107	G. Friesland	7285.50	289.19	3.97	285	
No. 121	G. Friesland	4707.00	201.41	4.28	300	
No. 57	G. Friesland	5046.90	207.68	4.12	271	Messrs Bluff Hill Dairy, Box 346, Salisbury
Bluffhill Betty	P.B. Friesland	6390.00	241.53	3.78	294	
Donkey	P.B. Friesland	6210.90	216.84	3.49	300	
Moff	P.B. Friesland	5015.40	201.71	4.02	300	
Simbi	P.B. Friesland	7430.30	297.35	4.00	300	
Palmtree Witrox	P.B. Friesland	7704.20	303.28	3.94	300	
Spoon	G. Friesland	6576.00	237.84	3.67	300	F B Morrisby, Sunnyside, Gwelo.
No. 102	G. Friesland	5902.00	210.30	3.56	300	
No. 16	G. Friesland	8735.00	295.02	3.38	300	
Viola	G. Friesland	10249.00	352.22	3.44	300	
Handie	G. Friesland	7453.00	238.99	3.21	300	
Breakfast I.	G. Friesland	4607.90	210.03	4.64	300	H. A Coke Norris, Laverstock, Umtali
Betty	G. Friesland	4961.00	200.41	4.04	300	
Blantyre	G. Shorthorn	4675.60	208.45	4.46	300	
Lily	G. Friesland	5187.40	216.04	4.17	300	
Tulip	G. Friesland	6414.70	324.69	5.04	300	Capt W M Nash, Chakadanga, Marandellas.
Camille	G. Friesland	5961.40	223.22	3.74	300	
Dolly	G. Friesland	6927.40	276.37	4.00	300	
Doody	G. Friesland	6634.80	296.01	4.46	300	
Daf	G. Friesland	4883.70	218.55	4.50	285	
Kufura	G. Friesland	4825.50	238.09	4.93	279	
Julia	G. Friesland	7049.00	260.87	3.70	291	Hon H V Gibbs, Bonisa, Redbank
Show	G. Friesland	6031.10	211.41	3.51	300	
Shy	G. Friesland	6024.40	223.54	3.71	300	
Laura	G. Friesland	6335.70	218.34	3.45	300	
Paris	G. Friesland	5842.10	252.95	4.33	300	Red Valley Est., "P" Herd, Lushington, Marandellas
Betta I.	G. Friesland	7763.60	273.45	3.52	300	
Grace	G. Jersey	5271.50	265.95	5.04	300	F H Maunsell, Forres, Bromley.
Piccanin	G. Friesland	5927.00	258.33	4.36	300	Boyd Clark Est., Castle Zonga, Inyazura
Beauty II	G. Friesland	7902.50	294.05	3.72	300	
Sunday I.	G. Friesland	6126.00	250.39	4.09	279	
Molly	G. Friesland	6526.00	255.00	3.81	300	
No. 49	G. Friesland	5884.50	226.82	3.86	292	
No. 274	G. Friesland	8266.50	279.61	3.38	300	Coldstream Dairy, Headlands
No. 276	G. Friesland	6086.00	238.79	3.92	269	
No. 320	G. Friesland	5010.50	218.09	4.35	282	
No. 243	G. Friesland	6338.50	240.70	3.80	294	
No. 321	G. Friesland	6000.00	225.05	3.75	300	
No. 245	G. Friesland	6415.50	278.33	4.34	300	
No. 289	G. Friesland	5438.50	218.91	4.03	291	

SEMI-OFFICIAL.—(Continued).

Name of Cow.	Breed.	Milk in lbs.	B. Fat in lbs.	Average % B. Fat.	No. of Days.	Name and Address of Owner.
Irene	G. Friesland	6341.00	308.24	4.86	300	J R. Bedford, Poltmore, Mangwendi, Marandellas.
Moffu	G. Friesland	5564.00	202.86	3.65	287	
Arrapence	G. Friesland	7550.40	339.93	4.52	300	
Maromben	G. Guernsey	7728.80	288.41	3.73	300	
Mavis	G. Friesland	8351.50	341.15	4.08	300	
Chipaka	G. Friesland	6546.00	267.66	4.09	300	
Betty H.	G. Guernsey	5672.40	236.96	4.18	300	
Esta	G. Friesland	7775.60	302.57	3.89	300	
Blakie	G. Friesland	4382.60	222.24	5.07	243	
Jemime	G. Friesland	8047.00	324.69	4.03	300	W E Tongue, North Lynn, Bulawayo
Kate	G. Friesland	9681.00	397.76	4.11	300	
Bridget	G. Friesland	8582.00	299.01	3.48	300	
Yshbel	G. Friesland	9829.00	300.79	3.06	300	
Valeries Natalie of Shanks	P.B. Guernsey	6815.40	376.43	5.52	288	A. Stokes, Safago, Gwelo
Polienta's Beauty of Shanks	P.B. Guernsey	10230.60	407.71	3.99	300	
No. 170	G. Friesland	6772.00	238.72	3.53	300	
No. 129	G. Friesland	7816.00	274.67	3.51	300	
Sir Nels Futurity II. of Shanks	P.B. Guernsey	6156.40	310.74	5.05	263	
Topmost Valeries Aurora	P.B. Guernsey	8694.50	365.78	4.21	300	
Valeries Mona of Delectus	P.B. Guernsey	6673.50	314.08	4.71	300	
No. 208	G. Friesland	8264.80	277.18	3.35	300	
Maria	G. Friesland	6200.60	205.30	3.31	282	Hon. H. V Gibbs, Bonisa, Redbank.
Butter	G. Friesland	7161.20	226.99	3.17	300	
Mafuta	G. Friesland	10746.10	369.39	3.44	300	
Rose May	G. Friesland	6126.20	227.90	3.72	289	T. Cousins, Oaklands, Gwelo.
Miripiri	G. Friesland	6235.20	285.64	4.58	243	
Stella II.	G. Friesland	6077.30	216.74	3.57	279	
Patty	G. Friesland	8170.20	394.03	3.60	278	
Astar	G. Guernsey	4897.40	201.55	4.12	300	W. D Haywood, Ordoff Farm, Gatooma
Larkhill Phillipa	G. Red Poll	5768.99	232.29	4.03	300	A. H. MacIlwaine, Larkhill, Marandellas
Larkhill Rita	G. Red Poll	6442.30	263.85	4.09	289	
23/7	G. Friesland	8310.00	279.48	3.36	300	Meikle Bros., Leachdale, Shangani.
186	G. Friesland	7577.00	263.84	3.48	300	
No. 53	G. Friesland	7237.00	282.50	3.90	249	
5/7	P.B. Friesland	6813.00	229.08	3.36	300	
11/7	G. Friesland	5627.00	203.77	3.62	269	
15/7	P.B. Friesland	5771.00	217.98	3.78	300	

9/7	P.B. Friesland	9327.00	300 77	3 22	300	Meikle Bros., Leachdale, Shangani.
8/7	G Friesland	7887.00	249 96	3.17	300	
4/7	P.B. Friesland	7688.00	273 81	3.56	298	
14/7	P.B. Friesland	7611.00	255.51	3 36	300	
26/7	P.B. Friesland	7458 00	287.94	3.86	300	
10/7	P.B. Friesland	9397.00	305 45	3 25	300	
187	G. Friesland	9929 00	378 28	3.81	300	
214	G. Friesland	6899 00	214 29	3.16	234	
20/7	G. Friesland	6948.00	251 61	3.62	267	
30/7	G. Friesland	4654.00	215 31	4.63	295	
15/7	G. Friesland	10927.00	359 70	3.29	300	
21/7	G Friesland	5297 00	206.40	3 90	286	
19/7	G. Friesland	8500 00	280 11	3 30	300	
32/7	G. Friesland	6714 00	240.93	3.59	289	
147	G. Friesland	7815 00	297.83	3 81	300	
17/7	G. Friesland	7638 00	275 00	3.60	300	
220	G. Friesland	6918 00	252 74	3 65	300	
5/7	G. Friesland	6280 00	259 41	4 13	278	
9/7	G. Friesland	6940.00	245 77	3 54	300	
24/7	G Friesland	6256 00	234 91	3 75	300	

OFFICIAL.

Matopo Drinkstone Missie III. 23.8.31	Red Poll	4140 8	153 44	3.71	300	Matopo School of Agriculture, P.B. 19K, Bulawayo
Matopo Drinkstone Missie I. 24.9.29	Red Poll	4991 40	191 00	3 82	300	
Matopo Olga. 19.2.37	Red Poll	3498 90	125 88	3.60	300	
Matopo Olive. 9.1.37	Red Poll	4384 04	182.04	4.15	300	
Matopo Nancy. 3.7.36	Red Poll	4954 10	201 59	4 07	300	
Matopo Kirton Stella I. 12.4.29	Red Poll	3661.10	131 95	3.60	265	
Matopo Kiora. 5.9.33	P B. Red Poll	6258 90	194 16	3.10	300	
Matopo Kodak. 14.9.33	Red Poll	6520.50	250.18	3.83	300	

Sales.

AGRICULTURAL EXPERIMENTAL STATION, SALISBURY.

SPINELESS CACTUS SLABS.

Delivery during September and October	100 slabs	7/6
Delivery during other months ... ... (not recommended).	100 slabs	12/6

Varieties: Algerian Muscatel and Nopalea.

KUDZU VINE CROWNS.

Delivery during September, October (for irrigated land). January for "dry land" ... ... per 100 crowns 15/-

SWEET POTATOES.

Tubers—Delivery during September and October. 7/6 per 75 lbs.

Cuttings—Delivery during January ... ... 6/- per bag.

Varieties: Virovsky, Early Butter, Linslade, Calabash Leaf.

EDIBLE CANNA TUBERS ... ... 6/- per 75 lbs.

GRASS ROOTS.

Delivery during January ... ... 6/- per bag.

Varieties: Woolly Finger, Swamp Couch, Creeping False Paspalum, Naivasha Star and Panicum Makarikari.

Napier Fodder ... ... 10/- per bag of 200 roots.

Cow Cane ... ... 10/- per bag of 200 roots.

The above are available in limited quantities only.

Owing to pressure of other duties and wartime reduction of staff deliveries cannot be guaranteed at times other than those stated, and living plant material cannot be sent beyond the borders of this Colony.

All the above will be delivered free by rail to any station or siding in Southern Rhodesia, but the price does not include Road Motor Service charges. Cheques should be made payable to the Accountant, Department of Agriculture and Lands, and preliminary enquiries and subsequent orders should be addressed to the Agriculturist, Department of Agriculture, Salisbury. (Sept.-Jan.)

Southern Rhodesia Veterinary Report.

AUGUST, 1941.

DISEASES.

No fresh outbreak.

TUBERCULIN TEST.

Two bulls and 35 cows and heifers were tested on importation. There were no reactors.

MALLEIN TEST.

Five horses and one mule were tested with negative results.

IMPORTATIONS.

Union of South Africa.—Cows and heifers, 36; bulls, 6; horse, 1; sheep, 839.

Bechuanaland Protectorate.—Slaughter cattle, 295; sheep and goats, 256; pigs, 30.

Northern Rhodesia.—Horse, 1.

EXPORTATIONS.

Portuguese East Africa.—Slaughter cattle, 120; cows, 12.

Northern Rhodesia.—Horses, 2; mule, 1.

Belgian Congo.—Bulls, 4; cows, 8.

Union of South Africa.—Horse, 1.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

United Kingdom.—Beef quarters (chilled quality), 1,406; buttocks, 127; boneless beef quarters, 194; tongues, 5,761 lbs.; livers, 10,123 lbs.; tails, 1,766 lbs.; skirts, 5,155 lbs.; hearts, 510 lbs.; fillets, 463 lbs.; cheeks, 3,207 lbs.; tongue roots, 544 lbs.

Northern Rhodesia.—Beef carcases, 253; mutton carcases, 54; pork carcases, 20; veal carcases, 2; offal, 11,841 lbs.

Belgian Congo.—Beef carcases, 172; mutton carcases, 305; pork carcases, 50; veal carcases, 10; offal, 1,462 lbs.

Meat Products from Liebig's Factory, West Nicholson.

Union of South Africa.—Corned beef, 712,152 lbs.; tongues, 2,304 lbs.; Vienna sausages, 11,268 lbs.; ideal quick lunch, 30,072 lbs.; lunch rolls, 15 lbs.; meat paste, 1,823 lbs.; beef fat, 10,100 lbs.; bone meal, 2,000 lbs.; cocktail sausages, 90 lbs.; pate de foie gras, 161 lbs.; ham and tongue rolls, 15 lbs.; chicken and ham rolls, 32 lbs.; jellied chicken, 30 lbs.; curried chicken, 30 lbs.

B. L. KING,
for Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-41

Monthly Report No. 105. August, 1941.

Movements of winged swarms have been reported in the following districts, namely: Salisbury, Lomagundi, Hartley, Nyanga and Melsetter.

A small swarm only visited Salisbury township on the 22nd, but the remainder of the reports refer to "large" or "very large" swarms.

The number of swarms reported is considerably lower than during August, 1940.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA

Agricultural Journal

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Editorial

Notes and Comments

Soya Beans.

In view of the many ways in which soya beans can be used, the Government considers that their cultivation should be encouraged and arrangements have been made to grant a subsidy, for a period of three years, on locally grown soya beans of type and grade approved by the Department of Agriculture and utilised for industrial purposes, that is to say, for milling into soya bean meal or flour, or for the production of soya bean oil, cake, plastic, etc.

Only the yellow seeded kinds will be eligible for the Government subsidy, and the best of these are the Hernon strains, recently developed at the Agricultural Experiment Station, and the one known as Potchefstroom No. 184. The Hernon strains usually yield 20% to 30% more heavily than P.184, but they require at least two weeks longer to mature and should be sown before mid-December; sowings of P.184 may continue for a week later.

Standard of Quality.—In order to qualify for the Government guaranteed price of 20s. per 200 lbs. nett, the beans must be sound, dry and plump; light yellow to yellow in colour; contain not more than 8 per cent. of off-colour grain and foreign matter, and be reasonably clean.

Further information can be obtained from Bulletins Nos. 1165 and 1183 (price 3d. each).

Beans obtaining the subsidy will be marketed solely through the Farmers' Co-op Ltd., Salisbury, and farmers may wonder why it has been decided to create such a pool. The reason is that this bean will never realise its full industrial value until suitable machinery is erected in the Colony for the complete extraction of the oil and the preparation of a product suitable for use in secondary industry (plastics, etc.). In order to justify the early erection of such machinery it is essential that all supplies of beans should be centralised in one channel. Otherwise the various oil expressors will merely handle the bean on their present machinery, extracting the oil and having left a bye-product which can only be utilised as cattle feeding cake or fertiliser.

Turkish Tobacco.

The Council of the Rhodesia Tobacco Association has announced that the immediate expansion of the Turkish tobacco industry is of national importance and has stated the following reasons for their finding:—

1. Turkish tobacco is the one crop which this country can grow successfully for export to the U.S.A. and for which there is an immediate and increasing demand. American dollars which are so urgently required are received in exchange. It thus becomes a national duty for those who can grow this crop to do so.

2. Full advantage should be taken now by this country to obtain a footing in this large potential market. This applies in particular to growers of Virginian tobacco, who would then have an alternative crop, thereby helping to insure themselves against a slump in the prices of Virginian tobacco.

The Minister of Agriculture and Lands while on his mission to the Belgian Congo was informed of the proposed campaign and forwarded the following message to the Association: "For the reasons stated by the Council, the Government is whole-heartedly in favour of this movement.

Every additional crop which a farmer can reasonably hope to produce at a profit lessens his risks and affords an opportunity of augmenting the farm income. Furthermore, the national importance of producing a crop which can be exported in large quantities to the United States cannot be emphasised too strongly. The new grower, however, should proceed slowly, and generally first trials should not be on a larger scale than 5-10 acres.

"The Minister heartily thanks the Council of the Rhodesia Tobacco Association for their patriotic and praiseworthy effort, and wishes the movement, and particularly new growers, every possible success."

It should be pointed out that this increased production must be conducted along sound lines. New growers, especially in untried areas, are advised to plant a crop on an experimental basis in order to test the suitability of soil and climate, and also to gain personal experience in the growing and handling of Turkish tobacco before launching out on a commercial scale. Detailed instruction in the production of Turkish tobacco is available in the Department's Bulletin, No. 1167, which may be obtained free of charge on application. Further notes on production, written by O. C. Rawson and W. J. Field, may be had from the Rhodesia Tobacco Association, Box 592, Salisbury. Prospective growers are invited to send in their names and addresses to the Department of Agriculture in order that a complete list may be compiled. The Chief Tobacco Officer will endeavour as far as possible to visit all new growers. Turkish tobacco seed, "Soulook" variety, is offered free and may be obtained as long as stocks last from The Rhodesia Tobacco Warehouse & Export Co., Ltd., Box 653, Salisbury, or The Turkish Tobacco Co-op Co., Ltd., Darwendale. Both of these firms undertake the handling and selling of this crop, and it is recommended that growers should send their tobacco when cured to one of these warehouses. The marketing prospects for Turkish tobacco are bright and remunerative prices should be obtained, so that it is hoped many farmers and Virginian tobacco growers will try some Turkish tobacco this year.

Treating Bones for Manure.

On most farms quantities of bones are found lying around. These are too small to sell to fertiliser firms for conversion to bone meal and consequently no use is made of them. The New Zealand Journal of Agriculture contains a note on reducing bones for manure, using quicklime or an old fermentation method.

(1) *Quicklime Method.*—Upon a 6 inch layer of bones place a 3 inch layer of lime and then a 4 inch layer of loamy soil. Repeat this process until a heap of practical dimensions has resulted, and then completely cover with a thick layer of good soil. Holes are then bored into the heap from the top and water poured in to slake the lime. For two or three months the mass of material will be very hot, but after this period the bones will be found to be satisfactorily reduced, and the whole heap may then be thoroughly mixed together. The "fertiliser" can then be either bagged and stored away or used immediately.

(2) *Fermentation Method.*—A heap of bone and soil is made as above (two-thirds bones to one-third good soil), and the layers thoroughly moistened with urine during the process of building. If obtainable, horse urine is better than cattle urine, but the latter is quite satisfactory and more easily procured. When completed a thin layer of soil on top will suffice, and from time to time additions of urine should be made. Normally a few weeks should be sufficient to reduce the bones to an effective condition. Then thoroughly mix heap and use as for method No. 1.

In manurial value both of the methods described should give the full phosphate-content of the bones used. As a relatively large quantity of more or less inert matter (soil) has been employed in reducing the bones to a usable condition, however, it will be apparent that a greater amount of the mixture will be necessary, say, per acre, than if the bones had been treated alone. By reason of the quicklime used in method No. 1 the resultant mixture will, of course, be greatly enriched in this calcium compound very essential in certain circumstances, but not so much in others. On the

other hand, the urine used to ferment the bones in method No. 2 will have added some nitrogen and quite a little potash to the final mixture.

Waste on Farms.

Writing in the Scottish Journal of Agriculture on "How to Increase Food Production," Sir John Milne-Home stated: "One of the most valuable, although the least spectacular, forms of increased production is the elimination of waste to the utmost possible extent." In time of war it is of prime importance that waste in all forms should be reduced to a minimum and, in considering this subject, suggestions will, no doubt, occur to farmers whereby economies may be effected and waste avoided. Mention will be made of some instances which result in waste, not in any spirit of criticism, but rather in an endeavour to stimulate thought and subsequent action.

Care of Implements.—Many implements are only used for a short period each year and are then often left standing out exposed to rain and sun until next required. The provision of adequate shed accommodation in which implements could be stored would avoid much deterioration. The thorough overhaul, cleaning and oiling of implements after use would prolong their life, and an overhaul some time before using again will often result in a considerable saving of time. Spares and replacements are becoming more and more difficult to obtain and every effort should be made to prevent damage to implements and reduce depreciation.

Native Labour.—The effective utilisation of native labour presents many difficulties, particularly at present when so many farmers are experiencing difficulty in securing sufficient labourers. Loss of time is perhaps the most serious source of waste in this connection, although this is largely overcome by the adoption of piece-work wherever possible.

Stock.—The keeping of stock under unfavourable conditions may result in a high death rate, or at any rate in unthriftiness—another form of waste. The keeping of herd records reduces waste by enabling unthrifty or unsuitable animals to be culled. Feeding too much or too little or the

use of ill-balanced rations is another form of waste which is perhaps rather difficult to control. This waste is particularly noticeable in dairying, where the high productive qualities which a cow inherits do not function until a properly balanced food supply in sufficient quantity is available. The constitution of the cows in the milking herd and of the young stock becomes so undermined, when adequate provision is not made for feeding, that their future capacity to produce is permanently impaired.

Harvesting.—It is not always possible to reap crops at the right time, but waste is avoided when this is done. Hay cut during a dry spell in February has about twice the feeding value of hay cut in April after the rains. Bean hay is grown for its protein content and should be cut when it will yield the maximum quantity of protein per acre—not too early, when it will have insufficient bulk, nor too late, when much of the leaf growth will be left in the field.

Cattle Dips.—Much has been written and spoken on the tremendous losses as the result of carelessness in the handling and storing of arsenical preparations (dips and locust poison). The large majority of such losses could be obviated by the provision of small lock-up stores solely for such products and by strict personal supervision in their use.

General.—Losses from vermin and insect pests can be minimised to a considerable extent by good management. In this connection regular readers of the *Journal* will, it is hoped, have absorbed much of the persistent propaganda presented by a contributor on the subject of agricultural hygiene. Much of this involves a two-fold saving, namely, the discouragement of pests and the utilisation of refuse. The use of otherwise waste material for making compost has also been dealt with on many previous occasions.

Breathes there a man with soul so dead
Who never to himself hath said:
"Cleanliness Aids Insect Control"?
(*Say it to your neighbours too*).

Harvesting Pyrethrum Flowers.

By H. C. Arnold, Manager, Salisbury Experiment Station.

Pyrethrum flowers of high quality are now worth £100 per ton at the factory in Durban. Such a high price should encourage growers to pay careful attention to the gathering of the flowers and subsequent treatment, in order that their value may not be reduced by incorrect methods of handling.

The price actually paid to the grower varies according to the amount of pyrethrins the flowers contain, in the same way that the factory price for cream, varies according to the percentage of butter fat the cream contains.

The main factor governing the pyrethrin content of the flowers is the stage of maturity at which they are gathered. If they are gathered before they reach the correct stage, their weight will be less than it would have been if they had been allowed to continue their growth for a few days longer. On the other hand, although "over-age" flowers have greater weight, their pyrethrin content is lower, and their value per ton is proportionately less. Extensive research work has shown that the most economical stage for harvesting the flowers is when from one-half to two-thirds of the tiny yellow florets composing the central disc have opened, but those in the centre of the disc are still closed. This stage is usually reached in from six to ten days after the white ray florets commence to open; the actual time varies with the climatic conditions prevailing at the time. In field practice, this entails picking all the wide-open flowers every third day for preference, or at least once a week. Care in picking should be exercised to see that none of the stalk remains attached to the flower after it is gathered. Ensure this by slipping the first and second fingers under the flower on either side of the stalk placing the thumb on top, at the same time bend the flower over to a vertical position and jerk it upward. In this way the flowers may be gathered entirely free from the stalks, which contain no pyrethrin and in common with

the leaves and other foreign matter have no commercial value. They should not be gathered while they are wet with dew or rain. The flowers should be placed in petrol tins or light baskets as they are gathered and should not be bruised by rough handling or close packing to save transport space. They should be spread out to dry as soon as possible after they are picked. Hessian-bottomed trays which are uniform in size and shape form convenient containers, as they can be placed in the sun or hurriedly collected and stacked under a shed or buck-sails if rainy weather intervenes. The layer of flowers should not be more than one to one and a half inches deep and they should be gently turned over once or twice each day. The layers must not be too deep or fermentation may set in and spoil the quality. The trays should be kept off the ground to allow air to pass freely underneath so that drying may proceed from below as well as above the layer of flowers. Another reason for keeping them off the ground is that the bottoms may be kept clean, so that when they are stacked no foreign matter will fall among the material in the lower trays.

In Kenya Colony most of the picking is done by native women and children. Experienced pickers can gather 60 lbs. or even more per head per day when working under favourable conditions. In some areas the pickers are paid at the rate of one penny per petrol tin of fresh flowers. The flowers are dry enough for packing when they can be easily crushed by pressure between finger and thumb. The dried flowers readily absorb moisture from the atmosphere and may require redrying if they are not kept in containers which are fairly airtight. Waterproof paper bags are recommended, or they may be tightly pressed into clean grain bags and stored in a closed, dry building. Bags made of the "Compo" hessian used by tobacco farmers would be excellent for this purpose.

In normal times gunny bags lined with waterproof paper can be obtained, and such would be suitable for storing the dried flowers and for transport to any place in Southern Africa. When the dried flowers are finally despatched to the factory each bag should be suitably addressed and bear the initials of the sender in order that each person's consignment may be readily identified upon arrival at its destination.

Cutting Seed Potatoes.

By H. C. ARNOLD, Manager, Agricultural Experiment Station, Salisbury.

The scarcity of seed potatoes this season has brought the question of the use of "cut" table potatoes for seed purposes into prominence. Many contrary opinions have been expressed on this subject. The controversy probably commenced soon after potatoes were first used for human food, and it still continues. The reason for so many diverse opinions is, no doubt, due to the numerous factors which affect the growth and yields of potato plants. The variety, size, age, condition, method of tuber division, method of storage, time of planting, the moisture and temperature of the soil, are factors which inter-play and affect the final results. It is well known that under certain circumstances even potato peelings may be used, and that when it is desired to propagate a variety as quickly as possible every tuber may be cut into as many pieces as the "eyes" it contains. The pieces are then grown under the most favourable conditions and a large number of new tubers are obtained from each parent tuber. Only when the soil and moisture conditions are very favourable to plant growth can the cutting of the tubers into such small pieces be practised with success.

The conditions under which our summer crop is usually planted are comparatively very severe. The tubers are planted in hot, dust-dry soil and they remain there for several days, or even weeks, before the rains arrive. During that period the growing shoots depend on the reserve materials in the tuber, and if these reserves are much depleted before rain falls, the subsequent development of the potato plants will be retarded and curtailed. To allow for a margin of safety, the pieces should weigh three to four ounces or even more, and they should have one or two short, sturdy sprouts.

Method of Cutting.—Experiments have shown that the main buds at the apex of the tuber have an inhibiting effect

on those at the base or "heel" end, and when the tubers are cut transversely after sprouts have formed the crop obtained from the "crown" ends may be considerably larger than that from the heel ends. In experiments conducted at the Salisbury Experiment Station, when tubers which had commenced to sprout some four months previously were cut transversely, immediately before planting in dry soil, on October 24th, 1932, the crown or apical halves yielded 50% more than the heel ends. A number of the heel ends did not survive, so there were several "misses" in the stand which adversely affected the yield. The yield from whole tubers was considerably higher than that of the crown ends of the cut tubers. It is seen, therefore, that when cutting is delayed until after sprouting has commenced it is advisable to cut the tubers longitudinally.

It should be added that the potatoes used were in the sixth generation from imported stock, and results more in favour of cutting would probably be obtained when recently imported stock is used.

The results of this trial indicate that when it is proposed to cut tubers into more than two pieces it would be advisable to do so before they commence to sprout, and thus counteract the inhibiting effect which sprouted apical buds normally exert over those at the heel ends of the tuber.

Another point which deserves attention is the treatment of the tuber pieces immediately after cutting. The cut surface exposes a large area to loss of moisture and fungoid attack. The potato tries to remedy this by exuding a kind of varnish known as "suberin." Subsequently a thin layer of cork cells, similar to those which make up most of the skin, are formed below the "suberin" and the cut surface is thus protected from disease attack, and loss of moisture is reduced. The deposit of suberin is both encouraged and hastened by keeping the cut tubers in a moist atmosphere away from the light for a day or two. Exposure to sunlight and dry air prevents, or at least reduces, the formation of suberin, and a patchy, defective covering of cork cells results. Imperfectly protected tuber-pieces become a prey to fungoid attack, and lose moisture and vitality much more quickly than those which are properly treated. It follows that cutting should

be done in a sheltered place, and the pieces should be covered with damp sacks or other protective material for a day or two (though not longer) to encourage the formation of an even and complete layer of suberin over the cut surfaces. They should then be stored in a cool, light, airy place where short, sturdy sprouts will develop. Diseased and shrivelled pieces can be discarded at planting time.

In tests conducted at the Craibstone Experiment Farm, Scotland, it was found that a coating of lime over the cut surface immediately after cutting prevented the surface from drying so quickly and the healing process was assisted, and there were fewer blanks in the crop than was the case when cutting was done in the sun and the setts were kept in a bright place.

Investigators have found that certain varieties will not "suffer" cutting. With one such variety at least, satisfactory results were obtained when about a quarter of an inch at the heel end was left uncut and the tubers were stored. The two halves remained attached until planting time, when the condition of the sprouts indicated whether they could safely be planted.

Experimental work has indicated that in general the size of the total crop reaped varies directly with the size of the cut setts. Although 1½ to 2 oz. pieces may be planted in damp land, the setts planted in dry soil need to have substantial reserves of food material and moisture, and it is doubtful whether anything is to be gained by planting pieces weighing less than 3 ounces. Allowing for loss of moisture during storage, it will be seen that only parent tubers which weigh 8 ounces or over at the time the crop is lifted are likely to provide seed pieces whose vitality is sufficient to withstand the severe conditions usually encountered when they are planted in dry soil and have to await the arrival of the natural rains before their sprouts can start making normal growth.

The high temperatures cause chemical changes associated with growth to take place in the parent tubers, but normal growth is impossible in the absence of moisture and so the rate of deterioration in the tubers is much faster in hot

weather than it is during the cool months of the year. If rain is long-delayed the moisture on the tubers is evaporated, and even though they may not be completely killed, their vitality is reduced and they are unable to provide sufficient nourishment to give the sprouts a good start.

It may be asked "Why plant in hot, dry soil?" "Would it not be better to wait until rain has fallen?" The reason is that high temperatures and in consequence sprouting cannot be prevented, and in order to prevent the sprouts becoming too long and spindly the potatoes must be stored in single layers in the light. This exposes them to tuber moth attack, which also commences with the beginning of the hot weather. The moths are difficult to combat and their larvae destroy the potato sprouts, hence the best way out of the dilemma is to plant the potatoes in the ground as soon as hot weather arrives, covering them with at least three inches of soil to prevent sunscald.

With reference to the use of lime for the protection of the cut surfaces, it may be added that wood ashes would probably be found to be equally effective, and as these are more readily obtainable most farmers in this Colony will prefer to use them.

It will be seen that owing to the widely varying conditions under which potatoes are planted in this Colony, it is not possible to lay down hard and fast rules. It should be remembered that the healing processes which follow cutting the tubers use up part of their growth sustaining ability, and for this reason the pieces of tuber should be somewhat larger than the whole tubers which would normally be planted under the conditions of soil fertility, moisture and temperature peculiar to each occasion.

Another factor in the more economic use of our potato stocks is the question of the storage of the seed tubers. Imported "seed" potatoes arrive here during the month of December. These are planted immediately and the resulting crop of tubers commence to sprout and are in the best condition for planting in the following September. Thus, when

stored at ordinary temperatures each crop of tubers reaches the optimum stage for planting approximately three months earlier than its parent stock was planted.

In the opinion of the writer, one of the causes of deterioration of our stocks is the necessity for keeping the seed tubers in high temperatures for some months after they have reached the optimum stage for planting. It is well known that when the natural growth processes of plants is checked by adverse conditions their powers of reproduction and resistance to disease are lessened.

The work of several investigators has shown that potatoes may be kept in cold storage at about 40° F. for as long as six months without being harmed in any way. In fact, in some cases the plants appeared to be sturdier and to yield more heavily than the control stocks which had been kept in ordinary storage. By keeping them in cold storage for three or four months sprouting could be retarded and controlled so that the main crop could be planted when climatic conditions are favourable to growth. By proceeding in this way with each generation of tubers it is thought that the cropping power of our imported strains might be maintained for a longer period.

Many Rhodesian farmers must have examined the interior of a termite nest. They must have been struck, or, on giving the matter a thought, will be struck in retrospect, by the combination of good organisation and cleanliness in these nests. Every scrap of refuse in the nest is turned to good account, or deposited where it is no threat to their economy.

Go to the (white) ant, thou sluggard;
Consider her ways, and be wise.

Cleanliness Aids Insect Control.

The Urgent Need for Conserving Supplies of Seed Potatoes.

By J. Sellschop, Officer-in-Charge, Hartbespoort Experiment Station, P.O. Brits, Division of Animal and Crop Rotation.

[*The following article, from* Farming in South Africa, *January,* 1941, *is reprinted for the benefit of the Rhodesian potato growers who are anxious to assist in conserving and increasing the limited supply of seed at present available. The field conditions, especially, apply to Rhodesia as well as the Union and the recommendations made by the author are suitable for employment in this Colony.*]

The Union faces a shortage of seed potatoes which promises to become acute unless available supplies are conserved. The shortage is due to the following causes:—

(1) On account of the exceptionally high price of potatoes during September and October last, considerable quantities of potatoes usually kept for planting have been used for edible purposes. The high prices followed a short crop owing to adverse weather conditions, and an unexpected increase in consumption which was due partly to troop concentrations in certain areas.

(2) The importation of seed potatoes has dwindled since (*a*) the usual number of orders was not placed in Scotland at the beginning of the summer, (*b*) growers of export potatoes did not plant more than was required for the actual reservations made with them, and (*c*) supplies of seed potatoes from Germany, France, Ireland and Holland stopped completely.

The Continental countries used to supply approximately 30 to 35 per cent. of the Union's requirements of imported seed potatoes and Scotland approximately 60 to 65 per cent.

The bulk of the seed potatoes imported by the Union is of the Up-to-Date variety, which is grown abroad almost

exclusively for the export of seed. It therefore follows that if more potatoes have to be planted for local consumption in the countries that export seed potatoes to the Union, the area planted to this variety will also be reduced.

It must also be evident that if a calamity were to befall the Up-to-Date variety a serious shortage would be experienced. Certain late, large white varieties, *e.g.*, Green Mountain, are obtainable from Canada and the United States of America, but it must still be demonstrated that they are as well adapted to our peculiar climatic and marketing conditions as is the Up-to-Date, which is not generally known in America.

From 1935 to 1938 the Union annually imported from 2,000,000 to 5,000,000 lbs. of seed potatoes. Largely as a result of the War, importations fell to 2,182,000 lbs. during 1939. The present import requirements are estimated to be about 6,000,000 lbs. For the current season import permits have been issued for only 2,353,700 lbs. According to trade statistics it is doubtful whether 20 per cent. of this quantity will be imported before January. The crux of the matter is that for the 1940-41 season more than a maximum quantity of seed potatoes was required to make up the normal wastage, as well as to replenish the stocks that have been used unexpectedly for edible purposes. That an exceptionally small quantity of potatoes is left for planting is reflected by the difficulty of obtaining both local and imported seed at present.

(3) It has been the practice to import seed potatoes at regular intervals to offset the rapid degeneration of potatoes grown in the Union. In the past there has been no difficulty in obtaining adequate supplies of relatively healthy seed from abroad, but as is now well realised, in time of war considerable difficulties may be experienced in importing seed.

In order to conserve all the available supplies grown from relatively healthy seed, degeneration should be checked as far as possible. Degeneration is not due to some mysterious condition of senility, locality, climate or soil, but to the presence of virus diseases. If the spread of these diseases is

checked, seed selected from the crop each year can be cultivated profitably for longer periods without the need of obtaining new supplies. Unless preventive measures are taken, the diseases causing degeneration spread very rapidly through a field containing but a few infected plants.

Small insects, chiefly aphids, that have fed on infected plants, carry the disease to healthy plants, and since the insects are practically always present where potatoes are grown, it is essential that diseased plants should be rogued out as soon as possible. There are many different virus diseases which affect potatoes and some of them are difficult to recognise, but for practical purposes the symptoms shown by affected plants are of a few types, and plants showing any of the symptoms should be dug out—not pulled out—since the tubers are also infected with the disease, and if they are left in the ground they are liable to be lifted with the crop and may be among the tubers selected for seed for the following season. Plants from such infected tubers will also be diseased and will constitute a source from which infection may be spread.

Besides carrying the diseases from one plant to another in the same field, aphids also travel from one field to another. Great care should, therefore, be taken not to plant healthy seed near a field known to contain a large number of diseased plants. Healthy crops should be isolated by planting a narrow belt of maize around them.

The symptoms shown by different varieties of potatoes vary, and the appearance of diseased plants is to some extent also governed by climatic conditions, such as temperature, humidity and light. Without going into details, it may be said that dwarf plants and those having rolled, puckered, mottled or mosaic like leaves may be suspected of being degenerate. Healthy plants are generally robust and have open, well-developed leaves with an even green colour.

The transmission of disease is not confined to the time when plants are growing in the field, and it is important to realise that even a wider spread may take place while the tubers are being held over from the time they are lifted until they are planted again. During storage large quantities of

seed are gathered in a small space and an insect can easily infect a large number of tubers, particularly when the tubers are beginning to sprout. Where aphids are troublesome in stores, seed potatoes may be kept in open sheds, or on wire racks lightly covered with grass, under trees. If the infection is detected before it has become extensive, the sprouts should be rubbed off carefully. Nicotine sprays should be used in preference to carbon bisulphide, since the latter induces too rapid sprouting, and excessive amounts are inclined to cause spindly sprouts.

It is characteristic of plants infected with virus diseases that they produce a high proportion of small tubers. It is a mistake, therefore, to select the smallest tubers for use as seed, since by so doing the chances of multiplying diseased seed are greatly increased. It is of primary importance to use seed which is as free from disease as possible. The appearance of a tuber usually affords no indication of the presence of virus diseases, but by roguing out plants showing symptoms of disease in the field, and avoiding the use of the smallest tubers, the chances of selecting healthy seed can be greatly increased.

Other sources of danger to the growing crop are weeds, especially "stinkblaar" (*Datura*) and gooseberries, and volunteer potato plants. Every effort should therefore be made to eradicate them.

(4) Considerable quantities of potatoes are sometimes rendered unfit for the production of seed potatoes, or even for marketing, on account of the presence of eelworm in the soil in which they are planted. To avoid this loss, potatoes and other related crops should not be grown continuously, or in close succession in the same field [*or under irrigation*—J.C.F.H.] and eelworm-infected seed potatoes should not be planted at any time.

To produce the maximum quantity of good seed-size tubers, potatoes should be planted close in the rows, and preferably late in the season.

For profitable return high yields are essential. It is important, therefore, that soil fertility receive due considera-

tion, and in this connection it may be said that the best response is obained from liberal applications of kraal or stable manure with some superphosphate.

While it has become most difficult to obtain seed potatoes from the few countries that used to supply the Union, and since other countries in Africa are looking to the Union as a possible source of supply, the control of virus diseases and eelworm infestation should be undertaken. This can be achieved by planting seed from healthy crops, the removal of weeds in and around potato fields, the removal of infected plants, the avoidance of walnut-size seed as well as seed of plants obviously infected with virus diseases and seed pieces showing the presence of eelworm. In addition, soils known to be infested with eelworm should, as far as possible, not be utilised for planting potatoes. If the above precautions are taken, it should go far towards easing the present difficult position.

Additional Note, by Dr. J. C. F. Hopkins, Senior Plant Pathologist.

Two serious causes of degeneration, namely "wildings" and "bolters," which are not due to virus diseases, have been omitted from the above article. These plants are extremely detrimental to commercial stocks and should be rogued rigorously from seed plots. Wildings are characterised by the production of a large number of thin haulms and numerous small sized tubers, which would to-day be sold as walnut-size seed. Bolters, on the other hand, appear normal until after the crop has flowered, when they can be detected by their later maturity, greater height, robust stems and large clusters of flowers. In crops raised from second-from-imported seed in Rhodesia, as much as ten per cent. of bolters are frequently seen. The mistake should not be made of selecting these plants for seed under the impression that they are more vigorous and therefore of higher yielding capacity than the remainder.

Walnut-size seed should be avoided and no tubers under 1½ oz. weight should be planted, unless their origin can be guaranteed.

The Department of Agriculture has commenced experimenting with the production and maintenance of "stock" seed at Inyanga. When war broke out, the present shortage of good seed was foreseen and permission obtained from the Imperial Government for the export from Scotland to Rhodesia of two dozen cases of specially high grade (N.I.(A) Certificated) Up-to-Date; all that could be obtained. This seed has been grown for two years, being rogued twice in the lands and once after lifting each season. In addition, the stored seed has been regularly culled for rotted tubers. Enough seed has now been obtained to plant stock plots at high elevations at Inyanga, Penhalonga and Melsetter, whilst a number of regular seed producers have been supplied with trial samples for testing at lower elevations under the guidance of the Senior Plant Pathologist. An attempt is also being made to establish a seed centre in Matabeleland.

Every scientific truth goes through three stages. First people say it conflicts with the Bible. Next they say it has been discovered before. Lastly, they say they have always believed it.—*Louis Agassiz.*

In Rhodesia, of course, we have always believed in agricultural cleanliness; we merely need more practice.—*Cleanliness Aids Insect Control.*

Sex-Linkage in the Pure Black Australorp.

By G. H. Cooper, Assistant Poultry Officer.

As far as the writer is aware it has not previously been shown that the Australorp carried sex-linkage within the breed. This article outlines how this was discovered at the Salisbury Poultry Station and how it can be applied by breeders of Australorps.

The sex-linked factor which has been used is the rate of feather growth of the primary wing feathers and later the main tail feathers. This comprises fast or slow growth and has been known to be sex-linked for a number of years. It has been used for obtaining sex-linked chickens in crosses such as the White Leghorn (fast feathering) with Rhode Island Red or Australorp (slow feathering). In most of these crosses, however, there is a margin of error which can now be explained because in some of the slow feathering breeds a few fast feathering individuals exist. In this article the words "fast and slow" refer to fast feathering and slow feathering birds genetically.

Fast and slow feathering are a pair of alternate mendelian characters. Slow feathering is dominant to fast feathering and the genes which determine them are located on the sex chromosome. In this manner sex-linkage using these characters is possible.

Recently work done at the Canadian Central Experiment Farm and in the U.S.A. has shown that in some pure breeds, notably White Wyandottes, both fast and slow feathering individuals exist and with this discovery it has been possible to breed them genetically pure for either fast or slow feathering and then by cross mating the types, always using fast feathering males, to secure sex-linkage by means of rate of feather growth within the pure breed.

Fig. 1.—Four wings from day-old fast feathering Australorp chickens. Note the length of the primary feathers and the alternate long and short growth. The top pair shows tips of wings exposed. Compare with the slow feathering wings. There is little possibility of confusion.

Fig. 1a.—Four wings from day-old slow feathering Australorp chickens. Note the primary feathers are much shorter and more even in growth than the fast feathering wings. In the bottom pair the primaries are so short they are not visible under the fluff

[I am indebted to Dr. J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A. for taking these photographs.]

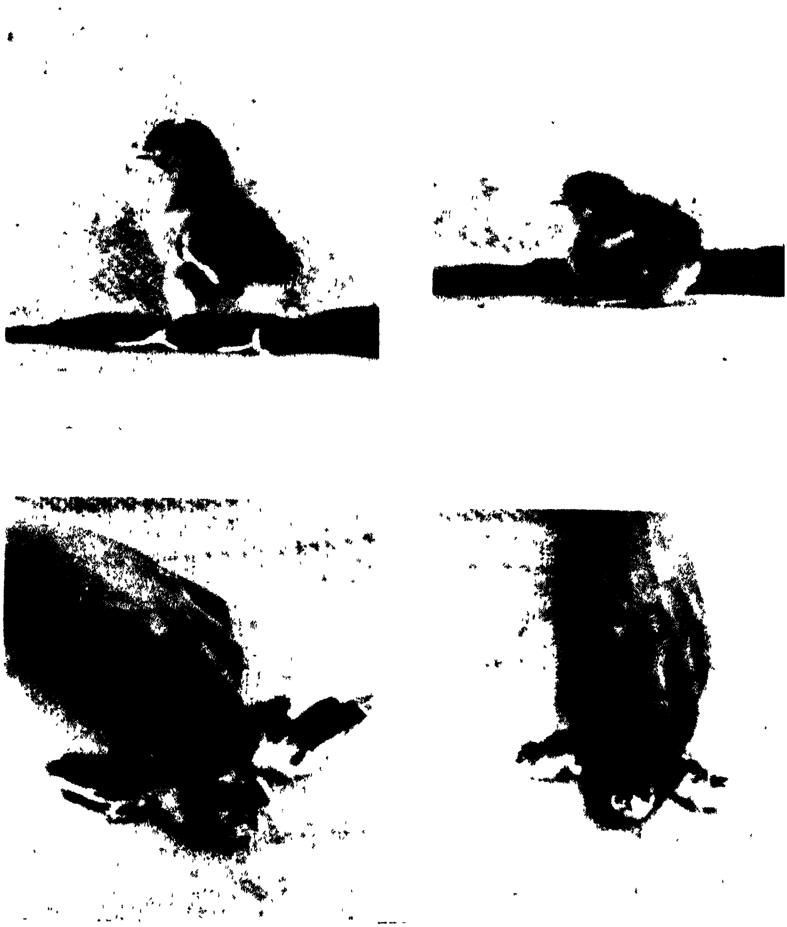


Fig. 2—On the left fast feathering and on the right slow feathering Australorp chicks at one week of age.

Fig. 3. – On the left fast feathering and on the right slow feathering Australorp chicks at two weeks of age.

It has been shown that most flocks of White Wyandottes (due to infiltration of Leghorn blood) have both fast and slow feathering strains. Rhode Island Reds are mostly slow, but a few fast individuals have been found to exist. White Leghorns and all Mediterranean breeds are pure fast feathering, whilst Sussex, Games, etc., are pure slow feathering.

It was thought that the Black Australorp would be an excellent breed to investigate on these lines, as it is one of the premier breeds in Empire countries in the Southern Hemisphere; rivalling the White Leghorn as a layer, it is probably the most popular general utility breed in these parts. It should have a great future in Britain and Europe once the traditional conservatism is overcome, because being white fleshed it is better suited to their market requirements than American breeds. The fact that it is sex-linked within the breed will enhance its commercial value.

Observations and Classification.—During the 1940 hatching season careful notes were made by the writer on all Australorp chicks hatched at the Government Poultry Station. Examination of the rate of feathering as shown by the primary wing growth was made at hatching and in addition the tail feather growth at 3 weeks, at 6 weeks and 12 weeks. It was soon evident that in this breed fast feathering individuals existed in our flock in fairly large numbers.

Although no previous experience had been gained in separating pure bred day-olds by this method it was found easy to distinguish the two types. When all the chickens had been classified no further work was done until maturity was reached, when final results showed that after culling there were 75 cockerels of which 28 were fast and 47 slow. Of 36 pullets kept 21 were fast and 15 slow. No previous knowledge of the rate of feather growth of the breeding birds was available, nor can it be ascertained once a bird is over 12 weeks of age.

Matings.—Early in the 1941 season the two most promising cockerels which showed fast feathering as chicks were selected and mated to pullets classed as slow feathering. One pen was mated as a flock and in the other individual matings were arranged in single pens.

Results.—The results of these matings are as follows:—

Pen 1.—Consisted of 8 pullets classed as slow feathering type when chickens, mated in a flock to a cockerel classed as fast feathering when a chicken. All the pullets were trap-nested. From this pen 80 chickens were hatched all of which were wing-banded at hatching and classed as fast or slow on examination of the wing primaries.

Fast and slow should be synonymous with pullet and cockerel in this sex-linked mating and of the 80 chickens 73, or 91.25%, were classed and, therefore, sexed correctly, which was proved by keeping them until the sex was easily distinguishable. Four chickens were wrongly classed and 3 were doubtful.

At 2 weeks of age 100% accuracy was easily obtained.

Pen 2.—Consisted of 6 slow pullets mated individually in single pens to a fast feathering cockerel. This was done to avoid any possible mistakes happening in the mating or egg marking.

From these pullets 47 chickens were obtained, which at hatching were sexed with 43 or 91.5% correct, one wrong and 3 doubtful. At two weeks 100% accuracy in sexing was obtained.

Accuracy improved in the later hatches at day-old with the experience gained, and at least 90% accuracy in sexing should be possible by anyone after a little experience.

Another pen consisting of fast feathering male and fast females was mated in order to secure fast feathering males for the future. The 100% fast feathering chicks of both sexes from this pen together with the results from the fast x slow pens proves conclusively the existence of the two types in the Australorps and that sexing the day-old pure Australorp chick can be practised.

Fast and slow feathering pullets in single pens have shown no differences in production ability nor do fast feathering pullets mature sexually faster than slow pullets.

Another matter of some importance is the annual moult, and in this respect the fast feathering birds have indicated

that they grow new feathers appreciably faster than the slow feathering birds which naturally allows for a shorter time out of production.

The Rules.—The rules which govern the rate of feather growth are as follows:—

1. All females are pure for the rate of feathering they exhibit regardless of their parentage. That is to say, fast females will transmit only fast feathering to their progeny; likewise slow females will transmit only slow feathering to their progeny.

2. Fast males are pure and will transmit only fast feathering to their offspring.

3. Slow males may be either pure or impure. The impure ones will transmit fast feathering to half of their offspring.

4. The male alone determines the feathering rate of his female progeny, in other words, the rate of feathering of females is determined entirely by their sire.

5. The female always transmits her feathering rate to her sons, but the sons also receive a gene from their sire. That is to say, males inherit equally from both parents.

These rules mean that all birds are pure for the rate of feathering they show, except the slow male, and his make up can be determined by the kind of daughters he produces.

Pure slow males produce all slow daughters and impure slow males produce both fast and slow daughters. Any slow male whose dam was fast must carry fast and is impure.

However, for our purpose only fast males are required, and so for practical sex-linkage work the slow male may be dismissed. He need only be used for producing slow females, and for this purpose even an impure slow male will probably produce sufficient for flock requirements.

Mating for Sex-linkage in the Pure Breed.—Fast feathering may be compared to red or gold and slow feathering to silver in the well known gold x silver crosses. Thus a fast feathering male mated to slow feathering hens produces fast pullets and slow cockerels, which with practice can be identified at

hatching as the results here show with 90 to 100% accuracy. Any breeder who has both fast and slow birds in his flock can practice sex-linkage within the pure breed.

It is necessary to emphasise that the two types must be genetically pure to obtain these results, and it is useless mating together birds which may show slight variation but which are both genetically slow or fast. If the differences are as marked as those shown in the photographs and explained in the text of this article, it may be taken for granted that the types are genetically pure but cross mating the types will prove or disprove it.

Classification when Young.—The most important part of the whole programme is to classify all the chicks at hatching, and if they are not wing banded to mark one sort with a toe punch and leave the other unmarked and then later when they may be desired for breeders their rate of feather growth will be known. This classification should be checked for accuracy at two weeks of age when differences are most marked. After 12 weeks it is impossible to differentiate the two classes accurately.

In order to assist breeders to classify their chickens at hatching the following points are important. (See wing photographs, figs. 1 and 1a.)

1. There is some variation in length of primary feathers at hatching but rarely enough for confusion.

2. Fast feathering individuals always possess primary feathers $\frac{1}{2}$ inch long or longer.

3. Slow feathering chicks primaries are never over $\frac{1}{2}$ inch long. They are usually less than $\frac{1}{4}$ inch in length.

4. Fast feathering chicks nearly always show alternate long and short growth in primaries, with a difference of $\frac{1}{8}$ inch to $\frac{1}{4}$ inch in length.

5. Slow chicks invariably have primaries of even growth or nearly so, seldom more than $\frac{1}{8}$ inch difference in length.

6. Tips of feathers bursting from the sheaths do not necessarily denote fast feathering—they are usually the early hatched chicks. Slow chicks may have wing tips exposed, but it is commoner in the fast chicks.

Practice counts a good deal, but the two distinctions of long or short primaries and even or uneven length make the classification easier. Comparison of a White Leghorn day-old with a Light Sussex will be a useful guide.

Selection.—By selection of very fast and very slow strains the differences will become more marked and thus easier to differentiate. Breeders should do this to facilitate the easier sexing of the chicks in future generations.

The differences are more marked at about two weeks of age between the two types than at any other time. (See fig. 3.)

At this stage fast chicks if they are thrifty and well grown have well developed primaries reaching to the end of the body and usually well defined tails from $\frac{1}{4}$ inch up to $\frac{3}{4}$ inch long. The secondaries are also well grown giving the whole wing an evenly balanced appearance.

Slow chicks have short primaries only half or three-quarters of the length of the body, with secondaries very much shorter giving the wing an unbalanced shape. They have no tail feathers.

Fast chicks have broad feathers with well rounded ends, whereas slow chicks have narrow wing feathers with constricted ends, especially in the rear secondaries.

Whilst this Station's Australorp flock was shown to contain both fast and slow feathering types, it may be found that in some flocks few, if any, fast feathering individuals exist, but the large percentage of these obtained from a few of our hens indicates that probably they will be found to be widespread in other flocks. If fast individuals are absent they must be introduced before sex-linkage can be practised.

Strains of pure fast and pure slow Australorps have been established at the Salisbury Poultry Station, and any breeder can do the same in two seasons if the two types exist in his flock, with very little trouble if the advice given is followed, and thereafter have sexed day-old chicks for sale.

The fast-slow feathering method of sexing day-old chicks will, in the writer's opinion, supersede the vent sexing method, because of its simplicity and cheapness compared to

the latter. It seems that soon all breeds that are not autosexing like the Barred Rock, Cambar, Golden Crele Leghorn, will be sexed by the feathering method in the future.

White Australorps.—The White variety being a true sport from the Black, is almost sure to contain some fast feathering individuals, as the Whites have been thrown from several strains. If not, fast feathering could be introduced from the Black.

Other Breeds.—Preliminary work in the same direction at this Station shows that fast feathering also exists in some of our Rhode Island Reds, though they are far less common than in the Australorp.

It is expected that by next year fast and slow feathering types of Rhode Island Red will also be established here and thus sexing at day-old will be possible with this breed by this method.

For the pure fast feathering and pure slow feathering breeds the alternate type required can be introduced by crossing, and has been done by geneticists in America with White Leghorns and Light Sussex. For the slow feathering breeds faster feathering is desirable apart from the sexing question to improve the growth rate, prevent sunburn, to facilitate plucking and to hasten the moult in adults.

Advantages of Sexing Day-old Chickens.—The chief advantages of sexing day-old chickens of the general purpose breeds are as follows:—

1. Pure bred day-old pullets can be sold, and the buyer need only have half the brooder and chicken rearing accommodation and equipment formerly required for a commercial laying flock of the same size. In addition, he has a much reduced feed bill for rearing and has no trouble with unwanted cockerels about the place.

2. Day-old cockerels can be purchased by the farmer at reduced prices for table birds.

3. If cockerels are not required by the breeder they can be sold at day-old to feeders before any expense is involved.

4. If both cockerels and pullets are kept by the breeder they can be reared separately from hatching, resulting in better growth all round.

5. Pure bred day-old pullets are usually sold at double the price of mixed chickens and day-old cockerels at half the price or less. Thus the breeder gets more for his sexed chickens; the buyer of pullets pays the same price per pullet but saves on equipment and outlay on feed, whilst the buyer of cockerels pays less for his table chickens.

Note.—A limited number of pedigreed fast feathering Australorp cockerels will be available at the next Station sale of pedigree stock usually held in March.

NO RIDDLE.

Q.: What is the difference between a good farmer and a bad farmer?

A.: One justifies agricultural cleanliness and the other just defies agricultural cleanliness.

Cleanliness Aids Insect Control.

A Note on Turkish Type Tobacco.

By D. D. Brown, Chief Tobacco Officer.

Following the publicity recently accorded to the production of Turkish type tobacco in Southern Rhodesia, considerable interest is being displayed in the cultivation of this crop. The following notes are published at the special request of the Rhodesia Tobacco Association and are issued primarily for the information of growers who are producing a crop of Turkish type tobacco for the first time.

Seed-beds.—In view of the difficulty experienced in obtaining supplies of cheese cloth, and also the fact that seed-beds for Turkish tobacco are sown during the wettest period of the season, it is recommended that long, cleaned grass or sunnhemp stalks be used as a covering in place of cheese cloth. Immediately after the seed is sown, grass is laid flat on the surface to hasten germination. Great care must be taken not to leave this grass on the beds after the seedlings appear —usually in about a week—otherwise the plants will grow spindly and die off. When this grass is removed, a framework of sticks and reeds is erected over each bed and about twelve inches above the surface. This is then covered with a thin layer of either combed grass or sunnhemp stalks, preferably the latter, to exclude the strong sunlight. After about ten days the covering material is thinned out a little, and from then on the thinning out process is continued at regular and frequent intervals until, when the plants are about five inches high, little or no covering remains. The plants are then hardened off so that they are better able to stand the shock coincident with transplanting into the field.

A suitable and well drained site should be selected and the beds should be raised at least nine inches above the general level of the ground. This will increase soil drainage and help to ward off fungus diseases such as "damping off" and "frogeye."

Fertiliser.—An application of 175 lbs. of a special fertiliser mixture containing phosphoric oxide 9%, nitrogen 3% and potash 9%, is the general recommendation for Turkish tobacco. The application may be broadcast either before planting or about two or three weeks after the crop is transplanted in the field. The latter method is considered advisable when the weather is excessively wet, as under these conditions the value of fertiliser applied before planting would be seriously reduced by saturation of the soil.

Curing.—After the tobacco is harvested, the strings are tied either to movable curing frames or to curing racks. The former are made 8 feet by 4 feet, hold ten strings, and can be moved under cover at night or when rain threatens. The latter comprise a series of parallel wires stretched over posts planted in the ground. The number of strings to each is limited only by the total length of the rack. While a few growers may still make use of the frame method, the majority cure their tobacco on racks, which are made just under four feet wide and three and one half feet above ground level. For tobacco harvested late in the season, it may be advisable to have the racks lower, say two feet above ground level, in order to facilitate the curing of leaf which might otherwise dry too green. The popular method of curing, when handling ripe leaf, is to place the tobacco on the racks during the late afternoon and cover the strings with grass hay to a depth of approximately twelve inches. Early the following morning the grass is removed and the leaf opened out on the strings and fully exposed to the sunlight. The tobacco is covered up with the grass every night and also whenever rain falls during the day. Later in the season the leaf does not colour so readily and it may, therefore, be necessary to keep the tobacco on the racks covered for the first day or two.

In conclusion, it may be stated that this note, giving but a brief outline, is supplementary to the comprehensive information published in the *Rhodesia Agricultural Journal*, December, 1940, by J. C. Collins, B.Sc., Assistant Tobacco Officer, and re-printed as Bulletin No. 1167. For detailed instructions growers are, therefore, referred to this Bulletin.

The Culture of Virginia Type Tobacco in Southern Rhodesia.

FIELD OPERATIONS.

By D. D. Brown, Chief Tobacco Officer.

At the outset it may be stated that the term "Virginia" as used in Southern Rhodesia denotes tobacco grown from varities originating in America, and serves to distinguish such tobacco from the "Turkish" or Oriental varieties originating in the Middle East. The term "Virginia type" is therefore rather a loose one and is used here and throughout South Africa to describe both dark and bright types, whether fire-cured, sun-cured, air-cured or flue-cured.

The tobacco plant is influenced greatly by the environment in which it is grown. Different soils and different climatic conditions bring about changes in the characteristics of the cured leaf. The evolution of well-defined types due to the influence of soil and climatic conditions has been in progress ever since tobacco became established in the Colony, and this natural process is being further aided by elimination of unsuitable varieties and types by the growers themselves.

Climatic Conditions.—For the production of Virginia type tobacco of good quality, the rainfall should be moderate, but well distributed throughout the growing season; precipitation in gentle showers is more beneficial than heavy downpours. The rainfall should be light during the ripening and harvesting period.

During the time when the crop is being transplanted, dull, misty days, with frequent showers of rain, constitute the most desirable weather conditions. As soon as the transplants are established in the field, sunshine is essential to accelerate growth. From the time the plants have taken

root in the field right up to harvesting, a full measure of sunshine is needed to assist in the proper development of the leaf.

A rainfall of 25 to 30 inches is sufficient for the production of Virginia type tobacco, provided it is properly distributed. Speaking generally, the average annual distribution in our tobacco-producing areas is fairly uniform, but if extreme weather conditions should prevail, a drought is preferable to an excessively wet season.

As the tobacco plant is very susceptible to injury by frost, the growing season must be sufficiently long to allow the crop to mature and be harvested before the first frost occurs. From the time they are transplanted in the field, the plants will generally reach maturity in from ninety to one hundred and twenty days. The growing season should therefore be of at least four months' duration.

Excepting abnormal seasons, the climatic conditions over the greater part of Southern Rhodesia are suitable for the culture of Virginia type tobacco.

Soils.—Tobacco can be grown on almost any soil, provided it is well drained, fertile, and the climatic conditions are favourable; but the various types of tobacco must be grown on soils best suited to the class of leaf desired, in order to secure optimum results.

In Southern Rhodesia tobacco cultivation is generally confined to three types of soil, *viz.*, sandy loams of granitic or sandstone origin; "contact" soils, which are found where granite and diorite, granite and banded ironstone; granite and schist or sandstone and basalt are in contact; or on clay loams, which are derived from diorite, banded ironstone or schist. These soils do not all produce the same type or class of tobacco and the leaf produced on each distinct type of soil has characteristics which distinguish it from leaf grown on the other distinct types.

The greater portion of the acreage under tobacco is planted on the sandy loam soils of granitic or sandstone origin. These soils comprise approximately fifty per cent. of the total area of the Colony, and vary in colour from white, grey, pink to light red, and are sometimes practically black where

highly impregnated with organic matter. The surface soil is usually shallow, from four to eight inches in depth, but soils derived from sandstone are generally deeper. Most of the sandy loam soils are somewhat lacking in plant food, but when properly handled produce fair yields of good quality bright leaf tobacco.

The "contact" soils are also sandy loams, but are finer in texture, more fertile and produce heavier yields of tobacco. This type of soil is seldom found in large continuous areas, but has proved highly suitable for the production of fine, firm, silky-textured, bright leaf with elasticity and good body.

The soils derived entirely or almost entirely from diorite. dolerite, schist or banded ironstone are usually red in colour, and may generally be classed as clay loams. These soils are usually fertile and produce heavy yields. Virgin land will produce fairly bright coloured flue-cured, sun-cured or air-cured leaf, but the tobacco produced from successive crops on the same soil is darker and lacks quality. Provided this type of soil is naturally fertile and contains a high percentage of clay, silt and humus, it will produce good crops of dark fire-cured, dark air-cured and sun-cured tobacco.

The texture of the soil used greatly influences the yield and quality of the tobacco produced. Coarse textured sandy soils usually produce low yields of poor quality leaf. On such soils, however, suitable applications of fertiliser and the use of properly made compost will bring about an improvement in both the yield and quality of the tobacco. Sandy soils of fine texture, when properly fertilised, produce large yields of silky, elastic leaf, which has good body and bright uniform colour.

The character of the sub-soil also has an important influence on the production and quality of tobacco grown on any type of soil. If the sub-soil is impervious, the plants will, in certain seasons, suffer damage through the land becoming water-logged. Should the sub-soil, on the other hand, be too porous, the tobacco may suffer from drought in seasons of light rainfall. Soil underlain by an excessively porous sub-soil will also not be retentive of artificial fertilisers. On shallow soils with a stiff clay sub-soil, there is a

tendency for the leaf to be dark in colour. In some localities, where a bluish-coloured clay sub-soil is found, tobacco growing is not recommended, as the plants are liable to suffer from "wet feet" when grown on soil underlain by sub-soil of this type. The most suitable sub-soil underlying the granite sandy soils is reddish in colour, and contains sand, clay and gravel in correct proportions.

It has frequently been noticed that some farmers are averse to using land which requires fairly heavy stumping when they can find land which requires little or no clearing prior to ploughing. That it pays to stump may be laid down as a general axiom. The timber is required for fuel for curing the tobacco; land which carries timber also contains more humus and is usually a better drained soil. If untimbered land is selected, it is advisable to plant tobacco only on those sections which are naturally well drained. Low-lying land and vleis which become water-logged during the rains are unsuitable for tobacco production.

Speaking generally, the best quality tobacco is produced on virgin and second year lands, and this applies particularly to sandy soils. This is attributable to the fact that, in newly cleared soil, there is a plentiful supply of humus, which improves the mechanical condition and assists in the retention of moisture and plant food. Land which is under continuous cultivation to tobacco will not produce good quality leaf, regardless of the quantity of fertiliser applied. The land should, therefore, be properly managed in order that the physical condition and humus content of the soil be maintained as near to the original state as possible.

Rotation of Crops.—The proper management of the soil demands the adoption of some suitable system of crop rotation. When the same crop is grown continuously on the same field, it naturally follows that the soil is not cropped to the best advantage and the incidence of plant diseases and insect pests is increased. Suitable rotation of crops is essential if the quality and yield of tobacco is to be maintained, and also for the prevention or control of the root-knot nematode (*Heterodera marioni*, Cornu.), commonly known as tobacco eelworm in tobacco fields The difference in the proportions of available plant nutrients assimilated and variation in the

root system and in the effects produced in the soil by different crops, are beneficially utilised in properly balanced crop rotations.

Variations in climatic conditions and soil requirements make it impossible to devise a single rotation suitable for general adoption throughout the country. In deciding upon the inclusion of any crop in a rotation, it is necessary to consider the effect on soil fertility and the influence on following crops grown. Consideration must also be given to the number of cash crops, their market value, market demand and their suitability under local climatic conditions.

The influence of any crop as it affects the maintenance of soil fertility is, as a rule, fairly obvious; so, also, are the virtues of the respective crops in controlling the incidence of plant diseases and insect pests. The influence of other crops on the quality of the tobacco is not so easily discernible, however, and in the absence of reliable data, growers are advised to make their own observations and follow their own experience.

Experience has so far shown that bright tobacco should not follow immediately after a legume in a rotation, as too much nitrogen may be accumulated for the production of good quality leaf. In the case of dark tobacco, however, good results are often obtained following a legume. The increasing evidence of nematode in tobacco land has emphasised the need for the use of non-susceptible and resistant crops grown in rotation with tobacco.

The question of the frequency of cash crops, soil improvement crops, market values and so forth can only be decided by the farmer himself, as he alone is fully conversant with the amount of capital available and the time and money which can best be spared in building up the fertility of the land and maintaining the quality and yield of tobacco.

The following rotations are suggested for the benefit of those who may be considering the introduction of crop rotations in their farming programme. Some modification may be required to render these proposed rotations more

suitable for local conditions and requirements. The continuance of any rotation schemes giving satisfactory results in present use is recommended until such time as some more suitable rotations may be established.

1. Four-course Rotation:—

   1st year—Tobacco—virgin land in first instance.
   2nd year—Tobacco.
   3rd year—Grass—for hay or grazing.
   4th year—Grass—for hay, stubble ploughed under.
   Repeat.

2. Four-course Rotation:—

   1st year—Tobacco—virgin land in first instance.
   2nd year—Tobacco.
   3rd year—Legume—ploughed under.
   4th year—Maize.
   Repeat.

3. Four-course Rotation:—

   1st year—Tobacco—virgin land in first instance.
   2nd year—Tobacco.
   3rd year—Legume—combination sunnhemp 30 lbs. and munga 12 lbs. per acre, composted and ploughed under with stubble.
   4th year—Maize.
   Repeat.

4. Five-course Rotation:—

   1st year—Tobacco—virgin land in first instance.
   2nd year—Tobacco.
   3rd year—Maize.
   4th year—Grass—for hay or grazing.
   5th year—Grass—for hay, stubble ploughed under.
   Repeat.

5. Five-course Rotation:—

   1st year—Tobacco—virgin land in first instance.
   2nd year—Tobacco.
   3rd year—Maize.
   4th year—Legume—ploughed under.
   5th year—Maize.
   Repeat.

6. Six-course Rotation:—
   1st year—Tobacco—virgin land in first instance.
   2nd year—Tobacco.
   3rd year—Maize.
   4th year—Legume—for hay.
   5th year—Grass—for hay or grazing.
   6th year—Grass—for hay, stubble ploughed under.
   Repeat.

7. Seven-course Rotation:—
   1st year—Tobacco—virgin land in first instance.
   2nd year—Tobacco.
   3rd year—Grass—for hay or grazing.
   4th year—Grass—for hay, stubble ploughed under.
   5th year—Tobacco.
   6th year—Legume—ploughed under.
   7th year—Maize.
   Repeat.

In each of the above examples it is assumed that the rotation has commenced with virgin soil being planted to tobacco. After completing the first cycle, it may be found desirable to grow only one crop of tobacco instead of the two stated. The same would apply in the case of starting a rotation on old land in place of virgin land. This would then result in each rotation being shortened by one year during the second and subsequent cycles, unless, of course, an additional suitable crop is introduced in the place of the tobacco crop.

Owing to the serious incidence of tobacco nematode, it is advisable that the choice of legumes and other crops used in rotation with tobacco should be restricted to plants resistant to eelworm attack.

Collins* gives the following short list of plants of economic importance known to be resistant to nematode infestation:—

*J. C. Collins, B.Sc.: "Notes on Tobacco Root-Knot Nematode." Rhodesia Agricultural Journal, May, 1937.

Velvet Beans—Florida, Mauritius, Somerset.

Cowpeas—Monetta (almost invariably), Brabham and varieties of Victor and Iron.

Sunnhemp.

Maize.

Munga.

Oats.

Soya Beans—Laredo variety.

Wintersome.

Peanuts—Most varieties, including Valencia, Virginia Bunch, Masimbika, Jumbo.

Grasses—All species.

Note.—Of the foregoing only "Somerset" variety velvet beans, "Valencia" and "Virginia Bunch" ground-nuts are available locally. "Laredo" variety soya bean is not available.

Amongst the plants commonly used in rotation with tobacco and stated to be hosts of tobacco root-knot nematode, are the following:—

Beans—Kaffir (*Vigna catjang*) and garden.

Cotton.

Cowpea—Most varieties except those enumerated in list of resistant plants.

Potatoes.

Sunflower.

"Nandora" or Dahl.

Pigeon Pea (*Cajanus indicus*, Spreng).

The pasture grasses, including Rhodes (*Chloris gayana*), Sabi grass (*Urochloa*), Buffels or Guinea grass (*Panicum maximum*), Rhodesian Sudan (*Sorghum arundinaceum*) are recommended for a temporary grass ley. If an annual grass or crop is required for conversion into hay or silage, the following may be grown:—Munga (*Pennisetum glaucum, syn spicatum*), oats—S.E.S., Kherson or Kinvarra only—sorghums, rapoko (*Elusine coracana*), teff (*Eragrostis abyssinica*), Annual Sudan (*Sorghum sudanese*) and "Crowsfoot" grass (*Dactyloctenium aegyptium*).

Detailed instructions concerning the establishment of improved pastures are published in the October, 1938, issue of the *Rhodesia Agricultural Journal* and reprinted as Bulletin No. 1084.

On a number of farms a system of tobacco production with grass fallow has been established and has given satisfactory results with bright tobacco. After two successive tobacco crops the land is allowed to revert to natural veld and, after an interval of from five to ten years, the cycle is repeated by the land being again cultivated and planted to tobacco for two seasons. This system is practicable only where there are considerable areas of land suitable for tobacco and where climatic conditions favour the rapid re-establishment of the natural grasses, otherwise serious soil erosion may result.

A rotation containing no legume but including small grain and grass crops which supply a considerable amount of organic matter to the soil is generally considered to be most suitable for the production of good quality bright flue-cured tobacco.

Preparation of the Land.—For the proper development of the plants and the production of good quality tobacco, the plants should make rapid and continuous growth in the field. The soil should, therefore, be thoroughly prepared and brought into good tilth before the crop is transplanted.

Virgin land should be stumped, cleared and ploughed during the preceding rainy season. Stumping is best done during or soon after the months of the heaviest rainfall, when the soil is thoroughly soft. A belt of trees should be left growing around the margin of the field to act as a windbreak. These shelter belts should be wide enough to leave room for a roadway running down the centre. The size of each separate field should not exceed fifteen acres. The advantages of limiting the area of each field and keeping them separate by suitable windbreaks are fairly obvious. Tobacco planted in such fields is protected from damage by wind and, to a lesser extent, by hail. Soil erosion is reduced and the spread of plant diseases and insect pests more readily controlled. Soil and atmospheric temperatures normally are higher and more uniform, and the growth of plants more rapid and continuous.

When clearing the land, all timber, including stumps and brushwood, should be removed from the field and not be piled and burnt on the land. Burning timber on the land is a waste of good fuel and is detrimental, as the heavy ash residues and the effect of fire on the soil will cause the tobacco crop to grow unevenly. The newly cleared ground should be ploughed—usually about March and April—while the grass and vegetation are still green and full of moisture, and before the soil becomes too dry and hard.

When handled in this manner it will be found that the land can be more thoroughly ploughed; all vegetation turned under is more readily decomposed and converted into humus and the soil is rendered more friable and retentive of moisture. After lying fallow during the winter months, the land should be ploughed and cross-ploughed, and then harrowed with a heavy disc harrow, being finally brought into a good tilth by means of drag harrows.

As already stated, the tobacco soils of Southern Rhodesia are generally rather shallow, and great care should therefore be exercised in the ploughing operations so that only the top soil is turned over by the plough. A quantity of the sub-soil brought to the surface through ploughing too deeply will have a detrimental effect on the crop.

Land which has already been under cultivation should be ploughed immediately after the crop is harvested, so that a certain amount of soil moisture may be conserved and to assist in the destruction of insect pests which may be hibernating in the soil. Such land should be ploughed again during the early part of the following season and brought into good tilth just prior to planting.

In the case of all soils, whether virgin or previously cropped, it is imperative to secure a good tilth before planting. Whenever possible, the final ploughing and harrowing should be made after the soil has been moistened by the early rains, since any weeds germinating at this time will thus be destroyed and subsequent weeding and cultivation will be reduced to a minimum.

To complete the preparation of the land, especially the lighter types, it is necessary to form parallel ridges through

the field. It is not so essential to make ridges on the heavy type soils. Ridging provides a greater depth of soil and consequently an increased area from which the plants may derive plant food. Soil drainage is also facilitated by ridges. These ridges should be made broad at the base and flattened off on top. Narrow ridges and hillocks are unsatisfactory and are not recommended. The spacing between the ridges is from three to four feet according to the type of soil and the type of tobacco grown. Light soils for bright tobacco are ridged at intervals of about three feet, while heavier soils for dark fire-cured leaf are usually ridged at intervals of four feet. If possible, the rows should be made to run east to west, so that the plants will receive the maximum amount of available sunlight. In this matter, however, the contour of the field will be the deciding factor. Ridges should be aligned diagonally across the slope of the field at an angle calculated to provide suitable drainage, and at the same time reduce the velocity of water flowing between each ridge after rainstorms. This will minimise soil erosion and leaching of fertiliser. On land where contour ridges have already been constructed for soil conservation purposes, the tobacco ridges should not be formed exactly parallel with the contour ridges, but should be placed, at a slight angle, otherwise there may be some risk of water-logging during heavy rains.

Suitably constructed storm-water drains should be provided where necessary for the protection of land and crops.

Around each field a strip of ground (say, twenty feet wide) kept free from weeds and grass, will assist in keeping down insect pests.

When the margins of the fields are straight and suitable pathways are made at convenient intervals across the field, much time and damage is saved during the working of the crop.

Manurial Treatment.—Until exhaustive experiments have been carried out in connection with the manurial treatment of each type of soil used for tobacco culture, it will not be possible to make any categorical recommendations concerning the application of fertilisers. Owing to the diversity of the types of soil, their varying degrees of inherent fertility and

lack of uniform treatment accorded in regard to tillage and cropping, it is only possible to deal with the fertilising of the crop in a general sense.

In this Colony the bulk of Virginia type tobacco is produced on the light sandy soils. These soils are naturally low in fertility, but respond readily to applications of fertilisers or manure. To secure good yields of desirable quality leaf, a complete fertiliser mixture containing the requisite percentage of phosphoric oxide, nitrogen and potash is needed. An understanding of the effects of the various fertiliser constituents on the growth, quality and yield of the crop is useful in determining the requirements for any set of soil conditions.

Phosphates hasten maturity, which is especially desirable in the production of bright tobacco. The supply of available phosphoric acid also increases the yield, improves the quality and is a very important factor in brightening the colour of flue-cured, sun-cured and air-cured leaf. An excessive quantity of phosphates in the fertiliser may affect a reduced yield by causing the leaf to ripen prematurely, especially on very light soils and during dry weather. Conversely, an insufficiency of phosphates, in relation to the supply of other nutrients, will cause delayed maturity and reduction in yield.

The supply of available nitrogen has a marked influence over the growth, maturity, quality and yield of tobacco. An excess of nitrogen, especially if unsupported by a sufficiency of other fertiliser compounds, particularly phosphates, will induce rank growth and delayed maturity in the plants. The leaf will be coarse and susceptible to disease and will be dark coloured and lacking in quality when cured. An insufficiency of nitrogen causes early ripening of plants, the leaf cures bright but lacks size and body. Temporary shortages in available nitrogen sometimes occur during prolonged heavy rainfall, particularly on the lighter type soils, and when the soil is cold and wet. Often such shortages disappear as the weather clears and the soil warms up. If the lack of nitrogen appears to be acute and the plants remain chlorotic, a top dressing of nitrogenous fertiliser should be applied.

Potash improves the body, texture and colour of the leaf, aids healthy development and increases the disease resistance of the plant. Applied in the form of sulphate, nitrate or

carbonate, potash improves the burning quality of tobacco. In the form of muriate, it has a detrimental effect on the combustibility of the cured leaf, and for this reason is not recommended for use as the sole source of potash in tobacco fertiliser mixtures. The effects of an excess of muriate on young plants are shown by thickening and brittleness of the leaf, curled edges and retarded growth. Muriate of potash, when used in moderation, tends to make a smoother leaf when the tobacco reaches maturity and renders the cured leaf more retentive of moisture. It has been generally accepted, however, that while the yield, smoothness, general texture and water-holding propensities of the leaf may be improved by the application of muriate of potash as a fertiliser, not more than one-third to one-half of the potash should be supplied in this form. A slight deficiency of available potash will cause the leaf tips to turn yellow and curl downward. A serious shortage results in the yellow colouration spreading down the margins and between the veins of the leaf. These yellow areas turn brown later and fall away, leaving the rest of the leaf, which is brittle, dark green, rough and ragged in appearance. When cured the leaf is coarse, brittle and lacks colour, body and elasticity.

The quantity of fertiliser mixture required per acre depends upon the inherent fertility of the soil and the proportions of the several elements of plant food contained in the mixture and the type of tobacco to be grown. It is false economy to apply light dressings which give the plants a good start, but do not provide sufficient plant food to carry the crop to normal maturity with a full yield per acre. In such cases the leaf is undersized and lacking in body, the colour is usually bright and the acre yield low.

Detrimental effects are also caused by too liberal an application of fertiliser; in this instance it induces a coarse, rank growth of leaf which is generally late in maturing, difficult to cure and of indifferent quality. Tobacco of this character is also more susceptible to attack by bacterial and fungus diseases when such are prevalent.

To produce satisfactory results the rate of application of fertilisers must be correct not only for each distinct type of soil, but should be adjusted to suit each individual field.

In Southern Rhodesia it has been found generally that an application of 175 lbs. to 200 lbs. per acre of a double complete tobacco fertiliser is an adequate dressing for bright flue-cured and sun-cured and air-cured tobacco grown on ordinary sandy soil of medium fertility. The rate of application is modified in cases where the soil is much above or below the average standard of fertility. On very poor soils the quantity of fertiliser is increased, and on soils above medium fertility the quantity is reduced to less than 175 lbs. per acre for bright tobacco production. If lower grade mixtures are used, the bulk should be increased proportionately. The double complete fertiliser for tobacco has the following water-soluble components:—Phosphoric oxide, twenty per cent.; nitrogen, seven per cent.; potash, ten per cent.

A mixture containing phosphoric oxide, twelve per cent.; nitrogen, six per cent.; and potash, eight per cent., is proving very satisfactory in the production of bright flue-cured tobacco,

The nitrogen in mixtures to be used for flue-cured, sun-cured and air-cured tobacco should be derived from organic and inorganic sources combined. For dark fire-cured and heavy sun-cured and air-cured types, the nitrogen should be derived mainly from an organic source such as fish meal.

For flue-cured tobacco grown on the heavier soils, it is advisable to supply the nitrogen entirely in an inorganic form, as this will tend to hasten maturity of the plants. In this case a mixture containing phosphoric oxide, eighteen per cent.; nitrogen, six per cent.; and potash, ten or twelve per cent. should be applied at the rate of 125 lbs. to 150 lbs. per acre.

An application of from 400 lbs. to 600 lbs. per acre of a mixture containing phosphoric oxide, twelve or eighteen per cent.; nitrogen, six per cent.; and potash, eight per cent. has been found satisfactory for dark fire-cured, heavy air-cured and sun-cured tobacco.

The time and method of application are next to be considered. Fertilisers may be applied broadcast and harrowed into the soil before the field is planted. This, however, is not the common practice in this Colony. A heavier bulk of

fertiliser per acre would be required for broadcasting. The established practice is eithei to apply the fertiliser at the required spacing along the ridges before planting, or to the young plants immediately after they become established in the field. The quantity of fertiliser required for each plant is measured out and applied, preferably in a line about four inches on either side, or in a circle around the plant and approximately four inches below the surface of the soil. Care should be taken to avoid direct contact between the roots and newly applied fertiliser, otherwise the roots may be damaged and plant growth retarded. When applying fertilisers before transplanting, the field is marked off and shallow holes made in the ridges at the correct spacing for planting. The requisite amount of fertiliser is then thoroughly mixed with the soil at the bottom of each hole. The tobacco seedlings are then planted in the depressions where the fertiliser has been applied.

In order to ensure as full and steady a supply of plant food as possible, especially on the lighter type sandy soils, the fertiliser may be applied in several dressings instead of the customry single application made either shortly before or after planting. The actual number and rate of applications made will depend upon the total quantity of fertiliser mixture to be applied per acre and the supply of native labour available for the task.

Such a system is recomended by Ellis* who states: "In order to make conditions as nearly comparable with the ideal as possible, it will needs become more and more the practice to apply fertiliser at regular or irregular intervals, depending on climatic conditions, to ensure each season the production of a high yielding, good quality crop. . . ."

"Evidence accumulated on general experiments showed clearly that it was preferable to keep the plant growing continually. This was achieved largely by applications of ordinary commercial fertiliser at varying intervals, dependent on the amount and intensity of the precipitation. . ."

*Annual Report of Tobacco Research Board. Publication No. 4, 1941, pp. 6-14.

"Where plants had been kept growing steadily and their nitrogen uptake was uniform, very much less disease occurred. This observation is similar to that stated by Naghaske, Harris et al., J. Bact., xxxviii. 2, that there is considerable resistance to spotting if the nitrogen is supplied uniformly during the period of active growth, but the plant becomes very susceptible if nitrogen is acquired erratically with considerable quantities available at the approach of maturity."

The application of top dressings, especially during or after periods of heavy rain, have proved beneficial, and Ellis has found a mixture composed of 80 lbs. Tobacco No. 4, 18—6—8, and 20 lbs. nitrate of soda very satisfactory for this purpose, and recommends that, if tobacco is to be top dressed, it should be done as early as possible, *i.e.*, when first the rate of growth shows a tendency to decline. This mixture is applied at the rate of 100 lbs. per acre.

To obtain the maximum benefit from the use of artificial fertilisers, it is essential that the humus content of the soil be maintained. It has been found that the continued use of fertilisers rapidly depletes the remaining humus and renders the soil lifeless. It is, therefore, necessary that the vitality of the soil be kept up by additional supplies of organic matter. Crop rotation and application of compost are the best means of maintaining the fertility of the soil.

Unsatisfactory returns follow the use of fertilisers alone on very open, coarse-grained soils; the soluble plant food is soon leached out of this class of land, especially during seasons of heavy rainfall. On these soils the use of either farmyard manure or compost is advocated for the production of bright tobacco. Farmyard manure, which should be old and well rotted, is applied broadcast at the rate of about six tons per acre, and about eight tons when used on heavy soils for dark tobacco; a supplementary dressing of fertiliser is applied later. Properly made compost, because of its greater freedom from weed seeds and insect pests, is preferred to farmyard manure for tobacco and should be applied at the rate of from five to ten tons per acre. Compost made from tobacco residues, such as primed leaf, scrap and stalks, may harbour tobacco diseases and, therefore, must not be used, as the plants may be contaminated.

In addition to the broadcast application of compost, the usual dressing of tobacco fertiliser must be applied to the plants. The application of from five to ten tons per acre of thoroughly decomposed compost is recommended not only for the open coarse-grained soils, but also for all sandy type soils generally used for tobacco.

The role which compost will play in crop production and in the maintenance of soil fertility is still undetermined, being but recently introduced in the treatment of tobacco soils. There are, however, indications that the use of compost may necessitate some modification in crop rotation for tobacco.

Transplanting.—When the seedlings are about six inches in height, they are ready for transplanting. Tobacco of desirable quality is rarely produced from unsuitable plants and the yield in most instances is disappointing. Seedlings which are less than four inches in height are sometimes used; these are too small and fail to make satisfactory growth unless the weather conditions are particularly suitable. A few hours of hot sunshine immediately after transplanting will either kill or seriously retard the growth of such small plants, while a heavy rainstorm may cause them to become buried in the soil.

On the other hand, overgrown, tough and woody seedlings are often planted in order to complete the intended acreage. This class of seedling, as a rule, does not make satisfactory growth; the flower head develops while the plant is still small, and, after topping, the leaves remain under-sized and do not ripen normally. Maximum results can hardly be expected unless the tobacco is transplanted during the most favourable period of the season. In Southern Rhodesia the highest returns from flue-cured tobacco are usually secured when the crop is transplanted during the latter half of November and up to the end of December. Speaking generally, tobacco planted early in the season will grow rapidly and reach maturity while the weather is still warm and before the rains have ceased; the leaf yellows well on the land, cures more easily and has good colour, body and texture. Conversely, when the tobacco is transplanted late in the season, the plants

usually reach maturity when the nights are cold and the soil and atmosphere dry, the leaf being generally small, heavy, coarse, leathery, dark-coloured and difficult to cure.

The best time for transplanting dark fire-cured, sun-cured and air-cured tobacco is generally from the beginning until the end of January, as in this case it is desirable that the tobacco reach maturity after the heavy rains have ceased, and before the weather becomes too cold. In areas where the advent of cold weather may be expected earlier than in the warmer parts of the Colony, the date of transplanting must be modified accordingly. A similar adjustment is required where the only available land is of a type which causes retarded maturity in the plants. If it is found to be absolultely necessary to plant out later than the periods found to be most suitable, then that portion of the crop which is planted late should be given an additional application of quick-acting fertiliser to hasten the development of the plants.

Transplanting is best done on dull, misty days with frequent showers of rain and every opportunity offering for transplanting the crop during such weather should be fully utilised. It is seldom, however, that the whole of the crop can be transplanted under these ideal conditions; the planting operations are controlled by precipitation, often in the form of local showers and also to a great extent by the degree of moisture in the soil itself. It is not advisable to transplant tobacco unless the soil contains sufficient moisture to prevent excessive wilting of the plants. Provided the soil is sufficiently moist, tobacco may be transplanted throughout the day, though the best time is during the afternoon, as the plants are subjected to less intense heat immediately after transplanting.

The seedlings are transplanted at regular intervals along the top of each ridge, or in the row when the field has not been ridged. Spacing of the plants varies according to the type of tobacco and the type of soil used. Plants for flue-cured, air-cured and sun-cured tobacco are spaced two feet to three feet apart, and for dark fire-cured and heavy air-cured and sun-cured, the usual spacing is two and one half feet to three and one half feet. Under average conditions, spacing plants for bright tobacco about three feet on ridges and three

feet apart, and for dark tobacco three and one half feet between plants by three and one half feet approximately between the rows, has given good results.

Before the plants are removed from the tobacco seed-beds, the latter should be thoroughly soaked with water so that the seedlings may be pulled up without damage. Diseased plants and those affected by eelworm should be discarded and destroyed, to prevent further damage to the crop. The plants are carefully packed in suitable receptacles, then transported to the field. Unnecessary exposure to direct rays of the sun should be avoided, otherwise the seedlings may be rendered useless through sunburn.

A short, pointed stick is used for making suitable holes in which to place the plants. These holes should be of a size which will accommodate the roots of the plant without difficulty and yet leave no unnecessary air spaces. The plant is carefully inserted until the root crown is about three inches below the surface, and then the soil is firmly pressed down around it. The tap root should on no account be bent up when the seedling is being transplanted; plants with a bent root seldom make satisfactory growth. Also the heart of the plant should not be placed beneath the surface of the soil. In order to test the work of the planters, an occasional plant should be grasped by the tips of the larger leaves and, if properly set in the ground, the plant will remain undisturbed though the leaves may be severed by an upward pull.

Every endeavour should be made to secure an even and full stand of plants right from the time when the field is first planted. An imperfect stand is, for the most part, due to unfavourable weather conditions, insect pests, plant diseases, or bad workmanship. It should be borne in mind that a poor stand of plants seriously reduces the yield per acre. At the same time plants growing around the margin of blank spaces in the field tend to produce leaf below the general average of the more closely spaced plants, thereby reducing the quality of the crop as a whole. Fresh plants should be transplanted to replace those which fail; such filling in should be accomplished as soon after the necessity arises as is possible. It is not advisable to fill in blanks when the adjacent plants have attained a fair size, for tobacco plants transplanted under

these conditions fail to make satisfactory growth, being dwarfed and over-shadowed by the bigger plants; hence the importance of refilling the gaps as speedily as possible. The average stand of plants should be eighty per cent. or over, if profit is to result from the culture of tobacco. Experience has shown that all necessary refilling of blanks should be completed within about fourteen days after the planting of the field. Any refills planted after this period are not likely to catch up with the rest of the crop and consequently will be late in ripening. Many of the difficulties experienced during the harvesting and curing operations can be traced to uneven growth of the crop in the field. These can, therefore, be minimised by the adoption of approved methods and the exercise of due care at the outset.

Cultivation.—As soon as the tobacco plants have become established in the field cultivation should commence. The first cultivation is shallow, so that the plants will not be disturbed. When the tobacco begins to grow properly, a thorough and deeper cultivation should be given in order to stir and aerate the soil. Subsequent cultivation must be shallow enough to avoid damage to the roots. When the tobacco is grown on ridges, this operation is best performed by the alternate use of the ordinary single-row cultivator and a wing-shovel plough; hand hoes should be used between the plants in the row. After the second cultivation the crop is best cultivated only as often as is found necessary to keep the field free from weeds. Cultivation with animal-drawn implements should cease when the plants are so large that the leaves are liable to become damaged. Any further cultivation which may be necessary for weed control should be done by hand. Care must at all times be taken to avoid cutting the roots during the cultivation of the plants.

The crop should not be cultivated while the soil contains a high percentage of moisture or when the tobacco is wet. Cultivation under such conditions is detrimental to the soil, which would become packed. The spread of diseases such as Angular spot (*B. angulatum*), Wildfire (*B. tabacum*) and mosaic is liable to become more rapid and more extensive if the tobacco is cultivated when wet. The spread of nematode, if present in the land, would also be greater. Over-cultiva-

tion is to be avoided, especially in the case of sandy soils, as stirring the soil hastens the losses of organic matter and adversely affects the natural structure of the soil.

Priming.—The removal of surplus leaves from the lower portion of the plant is described as "priming." The first priming should be delayed until the plants have been established in the field for at least four weeks. This has proved a useful method for mosaic control in the field. Apart from the removal of diseased and damaged leaves, especially from the bottom, no further priming is done until the final priming when the plants have reached the correct stage for topping.

Both operations may be carried out at one and the same time, but with the native labour employed in this Colony, it is advisable to have the tobacco primed by a gang of natives preceding those who are engaged in topping the plants. In order to control the spread of mosaic it is recommended that the labourers be required to wash their hands, at fairly frequent intervals, in suitable disinfectant during all occasions when they have to handle the tobacco in the field. In order to lessen the chances of the spread of plant diseases, the actual handling of the tobacco in the field should be reduced to a minimum. All discarded leaves are best carted off the field and destroyed.

Priming is a long established custom in Southern Rhodesia and is advocated for the conservation of plant energy and control of plant diseases, particularly white mould (*Erysiphe cichoracearum* D.C.). A recent report by Norval*, however, would indicate the possibility of some modification in the theory and practice of priming becoming necessary, if further investigations confirm his initial results which are stated as follows:—

"One of the most significant points from this preliminary experiment is the marked greening up of leaves after priming and the coincident check in growth. The dark green leaves produced after priming lead one to suspect an upset in the nitrogen balance of the plant. Such an upset has been reported by certain American workers (Naghski, Harris, Haley and Reid) to render the plants more susceptible to

*Annual Report of Tobacco Research Board, Publication No. 4, 1941, pp. 29

attack by bacterial diseases. Priming might, therefore, increase the susceptibility of tobacco to these diseases. Frog eye and Alternaria were of such minor importance that no differences could be observed between primed and unprimed plots.

"There are certain disadvantages apparent in the practice of priming. The handling of plants even if care is taken to avoid spreading mosaic still results in an extension of the disease. Plants may be delayed in reaching maturity, thus increasing the chances of damage from rosette. Under certain conditions the yield of saleable leaf is reduced.

"Experiments on priming will be continued, since it is important to know whether the control of leaf spotting diseases is sufficiently good to outweigh the disadvantages inherent in the practice."

Topping and Suckering.—In "topping" the terminal bud is removed from the plant to prevent the development of seed and to produce the maximum development of good sized leaf. The exact number of leaves which should be left on the plant cannot be definitely stated, but each plant must be treated as a unit and topped according to its merits. The correct number of leaves to each plant will be the number which it can carry to full development and maturity. In deciding on the height of topping, the type of tobacco grown, soil fertility and weather conditions are other factors which should be considered. The height of topping also has an important relation to the severity of infection from angular spot and wildfire. Plants topped too low are more severely damaged by these diseases than tobacco topped too high. The tobacco should be topped to produce the maximum yield without producing heavy leaf which may be practically destroyed by these diseases when they are prevalent.

When plants are topped too high the leaves do not develop body and the top leaves are small, narrow and late in ripening. On the other hand, if topped too low the plants produce coarse, heavy leaf which is slow maturing, difficult to cure and dark in colour. Plants topped at a medium height usually produce as good a yield as those topped high, and the leaf is larger and heavier bodied. Both experience and judgment are

required in this operation, but as a guide it may be stated that the usual height of topping for bright tobacco is twelve to fourteen leaves, and for dark tobacco ten to twelve leaves.

Topping should not be unduly delayed beyond the time for maximum results to be secured. Delaying the topping is wasteful of plant food and results in thin, papery leaf and reduced yield per acre. The stalk of the plant becomes tough as the flower head develops and the operation of topping is made more difficult. The proper stage at which tobacco should be topped is when the requisite number of leaves have developed and the bud has grown well above the topmost leaves. Topping should begin before the flowers open, and it is advisable to go over the field every few days until all plants have been topped.

Shortly after topping, suckers will appear in the axils of the leaves. Sucker growth is rapid and they must be removed or the whole object of topping will be defeated. For the best results the tobacco should be kept free from suckers at least until two-thirds of the leaves on the plant have been harvested. When a spell of wet weather occurs just as the tobacco is ripening, it may be advisable to allow the suckers to grow temporarily. Their growth will absorb plant food and help prevent secondary growth of the plants, which causes the leaf to become coarse and difficult to cure.

One necessary precaution to be taken during all operations dealing with priming, topping and suckering, is the division of the labour gang into two sections—one to deal only with clean, healthy plants, and the other to follow after and attend to those plants affected by mosaic and other diseases which may be present at the time.

Should there be a serious incidence of insect pests or plant diseases, the advice of the Entomological and Plant Pathology Branches, Department of Agriculture, should be sought.

In conclusion, it may be stated that the acreage planted should not be in excess of the barn accommodation available. The planting of too large an acreage results either in wasting tobacco in the field or ruin of leaf during the curing process through lack of barn accommodation and perhaps shortage

of labour. The relative acreage allowance to barn space is roughly in the ratio of, say, ten acres of flue-cured tobacco to each barn (16 ft. x 16 ft. x 20 ft.) and five acres of dark fire-cured tobacco to each barn (25 ft. x 16 ft. x 17 ft.). All types of air-cured tobacco will require approximately the same barn accommodation as dark fire-cured leaf.

The primary object should be the production of quality rather than quantity, and to this end intensive rather than extensive cultivation should be the policy adopted. It should also be fully realised that only the type of tobacco for which the soil is best suited should be grown. The conservation of natural resources in the form of soil fertility have already been discussed. It may not be out of place here to mention the conservation of indigenous timber, with special reference to flue-cured tobacco farms. Existing supplies of timber for fuel should be conserved by the use of barn furnaces specially designed and constructed for fuel economy. A tree planting programme should be planned and conscientiously pursued, in order to provide suitable reserves of fuel for future use. Establishment of tree plantations will also prove beneficial in providing shelter, assisting soil and water conservation and enhancing the capital value of the farm generally.

After the destruction wrought by this war the nation will have to live on the immediate products of its industry, and no production is more immediate, nor more truly wealth, than that which arises from the organised application of labour to the land.—*Sir A. Daniel Hall.*

Southern Rhodesia Veterinary Report.

SEPTEMBER, 1941.

DISEASES.

Anthrax was diagnosed on farm Boulder Creek, Gwanda native district.

TUBERCULIN TEST.

Fourteen bulls and 55 cows and heifers were tested on importation. There was one reactor.

The dairy herd at Hopedale Farm was tested and 26 animals gave positive reactions.

MALLEIN TEST.

Eight horses were tested with negative results.

IMPORTATIONS.

Union of South Africa.—Bulls, 20; cows and heifers, 55; horses, 8; sheep, 1,705.

Bechuanaland Protectorate.—Slaughter cattle, 19; pigs, 17; sheep and goats, 180.

EXPORTATIONS.

Portuguese East Africa.—Slaughter cattle, 42; pigs, 2.

Northern Rhodesia.—Cows and calves, 19; pigs, 93.

EXPORTATIONS—MISCELLANEOUS

In Cold Storage.

United Kingdom.—Beef quarters (chilled quality), 947; buttocks, 4,874 lbs.; rumps, 954 lbs.; pork carcases, 72; tongues, 9,719 lbs.; livers, 4,992 lbs.; tails, 2,384 lbs.; kidneys, 19 lbs.; fillets, 1,677 lbs.

Northern Rhodesia.—Beef carcases, 197; mutton carcases, 47; pork carcases, 29; veal carcases, 3; offal, 10,480 lbs.

Belgian Congo.—Beef carcases, 149; mutton carcases, 20; pork carcases, 40; offal, 627 lbs.

Meat Products from Liebig's Factory, West Nicholson.

Union of South Africa.—Corned beef, 75,772 lbs.; tongues, 3,024 lbs.; Vienna sausages, 2,940 lbs.; ideal quick lunch, 8,256 lbs.; lunch rolls, 1,441 lbs.; beef and ham rolls, 1,614 lbs.; meat paste, 1,770 lbs.; beef fat, 100,800 lbs.; Cambridge sausages, 120 lbs.; cocktail sausages, 1,005 lbs.; pate de foie gras, 249 lbs.; ham and tongue rolls, 1,983 lbs.; chicken and ham rolls, 1,653 lbs.; curried chicken, 240 lbs.

Portuguese East Africa.—Vienna sausages, 158 lbs.; ideal quick lunch, 24 lbs.; lunch rolls, 31 lbs.; beef and ham rolls, 31 lbs.; steak, kidney and onion, 24 lbs.; meat paste, 15 lbs.; beef potato, 16 lbs.; cocktail sausages, 45 lbs.; pate de foie gras, 16 lbs.; ham and tongue rolls, 31 lbs.; chicken and ham rolls, 31 lbs.

Tanganyika.—Lunch rolls, 16 lbs.; ham and tongue rolls, 16 lbs.

Mauritius.—Meat paste, 59 lbs.; pate de foie gras, 44 lbs.; ham and tongue rolls, 93 lbs.; chicken and ham rolls, 108 lbs.

Northern Rhodesia.—Meat meal, 4,000 lbs.; bone meal, 10,000 lbs.

Nyasaland.—Bone meal, 2,000 lbs.

Bechuanaland Protectorate.—Bone meal, 6,000 lbs.

Belgian Congo.—Bone meal, 600 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA
Locust Invasion, 1932-41.

Monthly Report No. 106. September, 1941.

Red Locust (*Nomadacris septemfasciata*, Serv.).—Winged swarms have been reported during September in eight districts, namely, Lomagundi, Hartley, Charter, Makoni, Umtali, Melsetter, Bulawayo and Wankie.

Some of the swarms have been small and straggling, having the appearance of remnants, but there are reports which appear to refer to at least seven (7) distinct swarms in different parts of the Colony, described as very "large" and "dense."

All specimens received at Salisbury retained the bright red migratory colouration. No indication of the activity of parasites or disease were obtained.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA Agricultural Journal

Vol. XXXVIII.] No. 12 [December, 1941

Editorial

Notes and Comments

News has been received that Sgt. H. D. Cazalet, Argyll and Sutherland Highlanders, was wounded in action on 25th November, 1941. Before the war Mr. Cazalet was manager of the Pasture Research Station, Marandellas. His friends and colleagues in the Agricultural Department wish him a speedy and complete recovery.

Natural Resources Board.

In terms of the Natural Resources Act, 1941, the following have been appointed members of the Natural Resources Board for a period of three years from 1st October, 1941.

Chairman: Sir Robert McIlwaine, K.C.

Members: Hon. H. V. Gibbs, W. R. Benzies, Esq., W. Sole, Esq.

The appointment of such a strong Board will be welcomed throughout the country and is a good augury for the successful working out of the provisions of the Act in a spirit of mutual co-operation and good-will.

It is fitting that Sir Robert McIlwaine should be the first chairman of the Board. He was the guide and inspira-

tion first of all of the Natural Resources Commission, which carried out such an extensive and thorough survey of the Colony, and later of the final legislation which he is now to administer.

The representatives of the farming industry—the Hon. H. V. Gibbs and Mr. W. Sole—are well known and should prove of great value to the new Board. The Hon. H. V. Gibbs has done magnificent work in the organisation of the Matabeleland Farmers' Union and on our contemporary, "Vuka." Mr. W. Sole is one of the most progressive farmers in the Mazoe Valley and his farm amply demonstrates the value of soil conservation and rotation of crops.

The other member, Mr. W. R. Benzies, late Superintendent of Natives, Bulawayo, has a wide knowledge of the country and his services will be particularly valuable in the native areas where much progressive work is being done.

Proposed Egg Marketing Legislation.

Following discussions between the Agricultural Unions and the Department of Agriculture, an outline of legislation for the orderly marketing of eggs in Southern Rhodesia has been drawn up. This has been drafted in semi-legal form in order that the proposals may be better understood by all concerned. The Minister of Agriculture and Lands desires it to be clearly understood that the scheme is a tentative one, which is now made public in order that it may be carefully examined and reported upon by the farming and commercial communities.

Briefly the general principle of the scheme is that all eggs produced in, or imported into, the Colony for sale shall, with certain exceptions, vest in and be subject to surrender to an Egg Marketing Board. The Board will pool the proceeds of eggs on a basis equitably recognising seasonal and other differences in value. It may operate several pools at the same time should that prove desirable. Costs of administration will be borne by the pools and the Board will be authorised to collect a levy not exceeding 1d. per dozen. Minimum wholesale and maximum retail prices at which eggs may be sold in the Colony shall be prescribed.

Producers are referred to the draft Bill which has been widely circulated for further particulars and it is earnestly hoped that thorough consideration will be given to it in order that the final legislation for the orderly marketing of eggs may be generally acceptable to poultry farmers throughout the Colony.

Broadcast Talks to Farmers.

A series of Talks to Farmers will be broadcast on Fridays at 8.30 p.m. These will deal with a wide range of subjects and should prove of great interest and vital importance to listeners throughout the Colony. Particulars are as follows:

Date	Subject	Speaker
20.11.41	Animal Husbandry in War Time.	Dr. A. E Romyn, Chief Animal Husbandry Officer.
28.11.41	Plant Pathology in War Time.	Dr. J. C. F. Hopkins, Senior Plant Pathologist.
5.12.41	Fertiliser Position in War Time.	A. D Husband, Chief Chemist.
12.12.41	Compost.	S D. Timson, Agriculturist.
19.12.41	Tobacco, with special reference to Turkish Type.	D D. Brown, Chief Tobacco Officer.
9.1.42	Dairying in War Time.	J. R. Corry, Chief Dairy Officer

Erosion and Malaria.

For some time Dr. G. R. Ross and Mr. C. C. Meeser, of the Medical Research Unit and Mr. D. Aylen, Technical Assistant for Soil Conservation of the Department of Agriculture, have been working on the Bindura Commonage on measures to reduce the incidence of malaria in the area. Though the work can at present only be considered experimental and is not yet completed, very encouraging results have been obtained.

On 7th November, Bindura held an anti-malaria day when the local community and interested visitors from all parts of the Colony were shown the work in progress. Only those who previously knew the area of old mine dumps, dams and swamps could appreciate fully how the simple and comparatively cheap anti-malarial drainage works had rid Bindura of an ugly plague spot.

In the afternoon Mr. Aylen gave a talk an Rural Prosperity, Erosion and Malaria, showing how intimately these subjects were interconnected. One result of erosion was the provision of increased breeding spots for mosquitoes with consequent danger of malaria. Erosion sapped the fertility from the soil, malaria sapped the individual farmer's strength and made him apathetic, with the result that farming efficiency was reduced and returns diminished. Great effort was required to break this cycle of reduction of health and income.

In the evening Dr. Ross gave a most interesting address on malaria in S. Rhodesia, outlining the life habits of malarial mosquitoes and indicating the precautions to be adopted to avoid contracting malaria. A bulletin on "Mosquitoes and Mosquito Control" has been issued by the Public Health Laboratory, Salisbury, and farmers who have not obtained a copy are advised to do so without delay.

Sulphur for Alkaline Soils.

In the course of each year several soil samples, mainly from gardens, are submitted to the Division of Chemistry for investigation into the reason for their infertility, and very often this is found to be extreme alkalinity, usually due to the injudicious use of woodash. It has long been known that applications of sulphur will rectify this state of affairs, but the exact quantities to recommend for soils such as ours had not so far been ascertained.

An experiment was accordingly designed to determine the optimum amounts of sulphur necessary to reduce alkanlinity and the following are the details: Varying quantities of sulphur were applied to two types of soil, one from a garden known by analysis to be extremely alkaline, and the other an ordinary loam soil rendered artificially alkaline to approximately the same degree by means of measured quantities of wood ash. The sulphur was thoroughly incorporated into the top 4½ inches of soil which was regularly watered. Determinations of pH to ascertain the degree of alkalinity were taken before, and at regular intervals after, the application of sulphur.

From these experiments it would appear that for all rates of sulphur application, the maximum reduction of alkalinity develops within one month. The most favourable application for a very alkaline garden soil rendered so by cumulative woodash treatment over a period of years, was found to be approximately 1lb. per square yard. The second soil, rendered alkaline artificially in the space of one month, only required half as much sulphur, but the former represents the type of soil found in practice.

"All war measures should be considered in the light of their effect in the post-war period. They should be directed towards making agriculture permanetly prosperous and providing sufficient food for the whole population. A flourishing agriculture and a healthy, well-fed population are the only sound basis of national prosperity and stability for our social and economic system. We have the opportunity to plan for that now. It will be too late to begin planning in the middle of the dislocations and disturbances which are inevitable when the war finishes."—Sir J. B. Orr.

"I venture to offer this opinion with some confidence, that the present consumption of milk is contributing in no small measure to the good health of the people, notwithstanding the rationing of staple foods and the inevitable wear and tear of the times."—Lord Dawson of Penn.

"The truth is, soil is a mere skin, a few inches thick, existing on a surprisingly small proportion of the earth's surface. This skin, unstable, and comparatively scanty skin, on which man's existence depends takes centuries to form, but can (and does) vanish utterly in the space of one storm of wind or rain *if subjected to a decade of unsuitable tillage*. And supremely unsuitable tillage is precisely what most of the soil of the world has been subjected to for the last ten decades."—From "The Wandering Years," by Weston Martyn.

Instructions for making S.R. National Bread.

In the evening make a "sponge" of 1 Double Crown Yeast Cake, warm potato water, 1 teaspoon salt and 1 dessert spoon sugar and sufficient flour to make a slack mixture—say ½ cupful. Keep in a warm place.

The following morning take about 4 cups flour 4 ozs. butter—or even more. Mix flour with "sponge" and knead with small quantities of *hot* potato water—or just *hot water*—and butter alternately until the mixture is of the right consistency. *Knead very thoroughly.*

Set aside to rise, then when risen *knead again* very thoroughly. Set into pans to rise again and bake in a steady hot oven for 50 to 70 minutes according to size of loaves.

The only secret of making a palatable bread of Rhodesian flour is:—

1. A good sponge.

2. Working mixture well with *hot* water (potato water for preference).

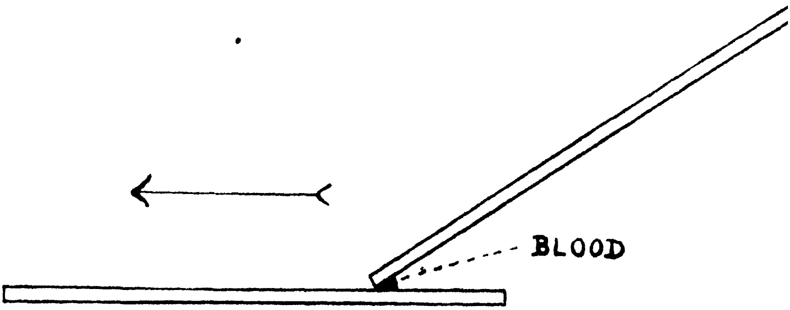
3. Plenty of fat (I am told that 50 per cent. butter and lard and 50 per cent. nut oil (Olivine) is as good as anything).

4. Plenty of work in kneading.

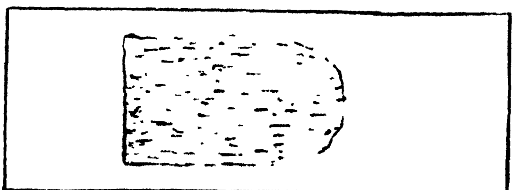
After baking allow to cool gradually under a cloth rather than exposed to the air.

Note.—The quantities mentioned should make 2 large full size loaves. Of course quantities can be reduced or increased in proportion.

Showing the method of holding the smear glasses when making a blood smear.



Relative position of the two slides and the drop of blood at the commencement of making a blood smear.



The film in a well prepared blood smear should extend over and be of similar shape to the shaded area above, and should be uniformly thin.

Laboratory Diagnosis of Disease

By J. M. WILLIAMSON, B.Sc., M.R.C.V.S.
Veterinary Research Department

PART I.—PREPARATION OF SMEARS.

Accurate diagnosis is of the utmost importance in the control of disease. On it depends treatment and prevention.

There are many ways in which a disease can be recognised and differentiated from other diseases—herein lies the art of veterinary science—but there is none so complete or comprehensive as laboratory diagnosis, particularly in those cases where, by laboratory aids, the actual cause of the disease can be demonstrated.

Of the various methods employed in a laboratory to identify diseases "smear" diagnosis takes pride of place in this country, where so many of our more important destructive diseases are caused by organisms which can be demonstrated and differentiated with the aid of the microscope. Redwater, gallsickness, East Coast fever, anthrax, quarter evil, and trypanosomiasis (tsetse fly disease) provide examples of these.

For diagnosis to be made by this means, however, it is essential that the smears be properly prepared, and although most stock owners have repeatedly received instruction in smear preparation it is still all too obvious that many of them continue to submit so-called smears which are utterly useless for examination, due entirely to faulty preparation. Others again, and these represent the vast majority, submit smears which, while being just capable of examination, are so poorly prepared as to render diagnosis extremely difficult and in some cases even uncertain.

Smears may be prepared from various body fluids or tissues, e.g., blood, lymph gland, spleen, oedematous fluids of quarter evil lesions, pus, etc., and from either the living or the dead animal. The final object of preparation in each

case is to secure a clean, uniformly thin film of the material, and the material only, no foreign matter such as dust or dirt being included, on a clean, clear, flat, glass slide.

PREPARATION OF SMEARS FROM THE LIVING ANIMAL.

Blood.—For this purpose special smear glasses are issued free of charge by the Department. As shown in the diagram these glasses are rectangular in shape, measuring 3in. long, 1in. wide, and 1-2 m.m. thick. The first essential to success is scrupulous cleanliness. When the correct glass slide is not available, a serviceable substitute can be prepared by cutting or even breaking a flat, clear, unscratched piece from a thin window pane. Flatness is essential and so-called smears that have from time to time been received on pieces of bottles have naturally proved utterly useless. If the surface of the glass is in any way dirty or greasy it is impossible to take a good smear.

When lifting smear glasses grasp them by the edge, since the hand is slightly oily and, if the surface is touched, this will prevent the blood spreading evenly or taking the stain properly. Having lifted a smear glass correctly, polish the surface with a *clean* cloth, e.g., handkerchief, then stand it up on its end on a clean piece of paper out of the way of dust while another glass is similarly polished. It is generally advisable to polish three or four glasses so that in the event of the first smear not being a success, other glasses may be lifted quickly and correctly before the oozing blood has a chance to clot. The next part of the procedure is to clean the edge of the ear at the site of the proposed incision. The assistance of a second person will be required to hold the head of the animal. The margin of the ear about 2in. from the tip is the best site at which to make the incision. Remove all the hair for a distance of 1 - 2ins. along it with a pair of scissors, then rub the hairless edge with a clean duster to remove any bits of scurf and cut hairs. With the point of the scissors make a small incision about ⅛ in. deep into the edge of the ear. A razor blade or very sharp knife can also be used for this purpose, but scissors are preferable. Generally this will be sufficiently deep to cause a small drop of blood to exude, if not, the cut may be flicked with the finger

until the blood begins to appear. It is important not to make the incision too deep, firstly, because the first drop of blood to exude is usually richer in parasites than subsequent ones, and secondly, because if the blood runs out freely it is difficult to avoid getting too much on the slide.

The actual technique of smearing the blood is simple, but requires a little practice. A polished smear glass is quickly but correctly lifted with the right hand and placed between the base of the thumb and tips of the fingers of the left hand as illustrated. A second smear glass is then lifted with the right hand and a small drop of the oozing blood—about the size of a millet seed—is collected on its under surface at the extreme end. No time should be wasted between the appearance of the blood in the incision and its transfer to the slide—delay will permit of clotting occurring and a good smear cannot be made from clotted blood. It is also futile to prepare a smear from the clear watery fluid (serum) which might be the first to exude from the incision, if bleeding does not occur properly. Having collected the drop by merely touching the exuding blood with the slide, the second slide is then applied to the first near one end to form an angle of about 30 degrees, with the drop of blood in the acute angle between the two slides (see diagram). As soon as this is done the blood will spread laterally between the surface of the first slide and the edge of the second. If the second slide is now pushed along the surface of the first towards the thumb a thin film will be left. The pushing should be done at a uniform and fairly rapid rate and at a constant light pressure.

In a good smear the film does not reach the end of the slide—the blood tailing off about half to three-quarters of the way along the surface of the slide (see diagram).

The mistake most frequently made is to take too much blood—as stated, a drop the size of a millet or munga seed is quite sufficient. An ordinary drop is about 5 to 6 times too much. If it is realised that too much blood has been collected on the slide edge, the slide should be immediately flicked to remove the excess. Having made the film, let it dry completely—a good film dries in 4 to 5 seconds. In damp, dull weather drying may tend to be slower and should be

hastened by briskly waving the smear. When dry, wrap it up in a piece of clean, non-dusty paper. In no circumstances whatsoever should another slide be stuck on top of the film.

Gland.—Gland smears are of importance in the diagnosis of East Coast fever, but since their preparation requires a certain knowledge of anatomy, the stock-owner need only rarely concern himself with these. Either the prescapular, precrural or parotid gland may be used; the prescapular, however, is generally the one of choice. This gland is located in front of and a little above the shoulder joint. In spite of the fact that it is covered by a muscle, it is possible to palpate it in the healthy animal. In an animal suffering from East Coast fever the gland is much enlarged, but though readily palpable, it is often extremely difficult to immobilise while a needle is inserted.

The only apparatus required is a large hypodermic needle measuring $2\frac{1}{2}$ to 3 inches long and smear glasses.

The animal should be securely held by the head, preferably in a crush pen or against a wall to prevent its moving away from the operator. Very large, powerful or fractious animals may have to be cast for the operation. When dealing with the right side of the animal the gland is grasped with the left hand, while the needle is inserted with the right. In the case of small animals it is possible to hold the gland sufficiently firmly with just the left hand, in larger beasts, however, it will often be found more expedient for somebody to immobilise the gland with both hands while the operator inserts the needle.

When holding the gland endeavour to force it superficially by placing the fingers and thumb behind it. The needle is pushed through the skin and covering muscle into the underlying gland. The fact that the gland has been pierced will be recognised by a "gritty" sensation. The needle is slightly withdrawn and reinserted into the gland two or three times. After the final insertion apply a finger firmly to the exposed base of the needle and withdraw it. The needle will be found to contain two or three drops of gland substance which are then blown on to a clean slide and smeared into a thin film. As an alternative to placing the finger over the base of the needle before withdrawing it, a syringe may be attached and

used to suck up a little of the gland fluid. The former method, however, is preferable. Gland fluid is not nearly so rich in cells as is blood and a thicker film requires to be prepared than in the case of a blood smear.

As with blood smears the gland smear should be allowed to dry completely before it is wrapped in a clean, non-dusty piece of paper.

THE PREPARATION OF SMEARS FROM THE DEAD ANIMAL.

Owing to the rapidity with which putrefaction takes place smears should be prepared as soon as possible after death. Even a few hours in hot weather allows the normal bacteria in a carcase to produce liquefaction of the various body cells in which the disease producing organisms are to be found, thereby interfering with diagnosis. This is especially true in the case of a soft internal organ such as the spleen.

Blood.—The essentials in this connection are *identical* with those described in the preparation of blood smears from the living animal. It is even more important here, however, that peripheral blood from the finer surface capillaries be used.

Putrefaction occurs most rapidly in the interior of a carcase and the organisms responsible for it only extend to the superficial parts later, hence blood from the deeper vessels is decomposed at a far earlier stage than that in the thinner extremities such as the ear or the tail. When more than a few hours have elapsed since the death of the animal, blood should be obtained for smear preparation by cutting into the ear or the tail. In other cases satisfactory blood can usually be obtained from the fine vessels severed during the skinning of an animal—in these cases it will be seen welling up as small drops in the subcutaneous tissues. On no account prepare smears from blood pouring out from large blood vessels or from that in the heart—it will not be nearly as well preserved as the other. Good smears cannot be prepared either from clotted blood or from serum, but the former, if necessary can be broken down between the slides and then smeared out and prove serviceable for examination, whereas the latter is never of any use.

If there is any suspicion that a beast has died of anthrax the carcase should on no account be opened; all that is required for diagnosis is a blood smear, and this should be made without cutting into any part other than the ear or tail.

Spleen.—Spleen smears are of special significance in the diagnosis of East Coast fever. When forwarding smears from any dead animal a spleen smear should always be included, except, as mentioned above, where there is reason to suspect anthrax. The actual technique of making a spleen smear differs slightly from that employed in the making of blood smears.

A deep incision should be made into the substance of the spleen with a knife. A little spleen pulp is then collected on the end of a smear glass by scraping the glass along the cut surface. This is applied to the surface of a second smear glass, as described in the preparation of blood smears, but this time the glass upon which the smear is to be made should be held at one end between the finger and thumb of the left hand. The smear is then made by drawing the first smear glass along the surface of the second, with the spleen pulp in the angle between the two glasses. It will be noted that in the case of blood smears the glass used for making the smear is pushed towards the thumb of the left hand, while in the case of spleen smears the direction is reversed, the action being a drawing instead of a pushing one. As in the case of blood smears the usual tendency is to make the smears too thick. If the smear does not appear to be quite right it is preferable to make another one, rather than to attempt to alter the first by again drawing the glass across its surface.

Muscle, Gland, Pus, etc.—The procedure in preparing muscle, gland and pus smears is similar to that described under spleen smears. Muscle smears should always be submitted when it is suspected that quarter evil was the cause of death. The smear should be taken from the actual lesion. In practically all cases this is easily found as a crepitating swelling in some muscular part of the body such as the shoulder or hind quarter. On cutting into this there is seen a large amount of blood-stained, dirty-red or claret-coloured slightly frothy fluid under the skin. Towards the centre of the lesion the tissue is dry, black or blackish-red and the

muscle fibres are dissected by gas formation. Such muscle cuts with a sound like cutting inflated lung, and has a strong odour of rancid butter.

Before assuming that gassy swollen quarters are the result of quarter evil one should obtain a general impression of the state of preservation of the carcase—any carcase in which decomposition is advanced tends to swell and get gassy. In quarter evil, even although the rest of the carcase is perfectly well preserved, the characteristic gassy swelling is present.

Gland smears are prepared in the same way as spleen smears, the pulp being obtained by scraping the cut-surface of the gland selected, usually one of the large and fairly superficial glands.

Similarly, pus smears can be made from the pus contained in any abscessed organ.

POINTS TO REMEMBER.

The following points deserve special emphasis:—

1. Diagnosis of a disease is never more certain than when based on smear examination. Treatment and prevention depend on accurate diagnosis, therefore in cases of sickness or death submit smears.

2. Smear preparation requires considerable care, especially in regard to cleanliness and thorough drying of the film.

3. In the case of sick animals blood smears only are required unless East Coast fever is suspected when gland smears as well are essential.

4. Preparations from dead animals should be taken as soon after death as possible. Always submit blood and spleen smears unless anthrax is suspected, when, as the carcase must not be opened, only blood smears can be prepared. For the definite diagnosis of quarter-evil, muscle-lesion smears are required in addition to blood and spleen smears.

5. Always give the following particulars: Name and address of owner, nature of preparation, kind of animal, ante- and post-mortem history, disease suspected.

(*To be continued.*)

Pitsaving.

By E. J. KELLY EDWARDS, M.A., DIP. FOR. (OXON.),
Conservator of Forests.

At the present time when squared timbers are both costly and difficult to obtain the ancient but extremely serviceable method of ripping wood with the pit saw is well worth consideration.

In the hands of expert sawyers the pit saw can achieve work of great accuracy, so that in most cases no resawing is required to obtain squared timber of the required dimensions, but to those who are in possession of mechanically driven circular saws of low power the pit saw is very useful in the preliminary breaking down of large logs.

The following article does not pretend to give an exhaustive account of pit sawing. Expert pit sawyers have various labour saving devices and "gadgets," but the article gives the main essentials which will enable even the novice to train two intelligent labourers to carry out what is really a very simple and cheap operation. If trained pit saw boys are available they should be engaged on the best terms possible, as they are worth it. If none are available all that is required is a few days patience to give the necessary training. Training should start on a poor quality log, and not on the special log which has been held until a suitable opportunity presented itself to saw it for a special piece of furniture.

In brief, pitsawing requires two operators—guide and sawyer—a specially designed rip saw, a pit (or platform) of sufficient depth to allow the sawyer to stand comfortably upright, two or three transverse movable logs of equal dimensions to carry the log to be sawn and wedges or clamps to hold the log in position.

THE SAW.

Fig. 1 shows two pit saws with 6 feet blades. The broader top portion of the blade carries the handle used by the guide.

The lower tapered portion is provided with a double grip with a slit to envelop part of the blade, to which it is attached either by means of a wooden wedge or by a pair of bolts. The grip is readily detachable to allow the saw to be taken out of the saw cut.

At the present time a 7 feet rip saw costs about £4 and apart from the small cost of a saw set and files, and of course the labour employed in digging the pit and operating the saw, this is the sole outlay.

It is highly important that the saw should be correctly set and sharpened before use, and that setting should take place before sharpening. The saw teeth should be "spring set," i.e., the teeth are bent right and left alternately exactly the same amount on both sides. The amount of set to be given must be determined by practice and will largely depend on the type of wood to be sawn—the wider the set the more exertion required and the greater the "kerf" and waste of wood. If the teeth are set exactly equal on both sides the saw may be worked with less set than if the teeth are irregular. Generally the set should start from about one-third of the way down the tooth and should never start at the root of the tooth.

In sharpening the saw avoid files with sharp corners, hold the file level and at right angles to the blade so that the tooth is filed square across the face.

THE PIT.

An average pit (Fig. 2) would be about 10 feet long by 3 feet 6 inches wide and 5 ft. 6 ins. in depth, due allowance being made for the fact that the log to be sawn will be higher than the top of the pit by the amount of the diameter of the transverse bearers.

MARKING THE LOG.

The log to be sawn is first barked, crosscut at both ends and then placed on the transverse bearers in such a position as to obtain from it a square or rectangular baulk of greatest dimensions if squared timbers are required, or, if planks of a certain thickness are wanted, in such a position that the greatest number as wide as possible can be obtained.

The log shown in figure 5 was intended to produce 3in. x 2in. material.

A nursery or mason's line is now soaked in a mixture of ground charcoal and water and is drawn taut along the length of the log so as to give one of the lines shown on the log in Fig. 4. The tautened line is then pulled up in the middle and released to leave the black mark shown. The same line (or a shorter) with a plumb-bob attached is then used at both ends to give corresponding marks across the cross-cut faces From these lines the required width of the baulk is set off at right angles at both ends making due allowance for the kerf of the saw. The plumb is then placed so as to fall through the marks so obtained, and the vertical lines are struck as before. The two ends are then joined by the charcoal line, which is tautened and released to give the second mark shown in Fig. 4.

The whole log is then turned over through 180 degrees and corresponding marks made along the original underside of the log by joining up through the vertical lines previously obtained.

Instead of a plumb bob a builder's level can be used for the vertical lines and in the case of a log which is to be sawn to produce planks of a given thickness but any width all the marks are made beforehand.

SAWING.

The log is now set firmly on two transverse bearers and is kept in position (after ensuring that the vertical marks are truly plumb) by means of wedges as shown in Fig. 3, or longitudinally placed poles (Fig. 5) or by a series of spikes. The spikes may be made by bending over at right angles a bar of iron three feet in length nine inches from each end and pointing the ends. One end of the clamping spike is driven into the transverse bearer and the other into the log. Spikes are particularly useful with logs of small diameters or sawn material of small dimensions.

The operators then take up their positions as shown in Figs. 5, 6 and 7 and the first cut is made by a series of short strokes until there is a sufficient depth of cut to ensure that the saw is working in the correct plane. The functions of the

Fig 1—Types of Pitsaw

Fig 2—Pit with transverse bearers.

Fig. 3.—Marking vertical line by use of plumb bob.

Fig. 4—Marking the longitudinal lines

Fig 5—Baulk being finally squared Note switch in guide's hand and method of gripping handle

Fig. 6—Temporary platform to show position of sawyer.

Fig 7—Temporary platform to show positions of guide and sawyer.

Fig 8.—Inch boards stacked for seasoning Note foundation log Foundations should be about two feet apart.

top operator—the guide—are to raise the saw from the downward stroke, to see that the saw works in one plane and to ensure that it holds to the line. *He does not saw nor push down the saw.* That is the function of the sawyer below who performs the actual ripping stroke. This is a steady out-down-in pull somewhat reminiscent of the action of a man sculling a boat standing and facing the direction of the boat's progress. The action of the two operators is not a continuous up and down motion. The guide pulls up the saw and there is a pause, the sawyer sweeps the saw down, at the same time following his line on the under side of the log, and there is another pause followed by the upward and backward pull of the guide. The latter often provides himself with a horse-tail switch with which he brushes aside the saw dust which tends to collect and obscure the marked line. This he performs with a neat flick in the momentary pause which follows the downward stroke.

The cut on the first line proceeds for a few feet, e.g., to the guide's right foot in Fig. 5. The saw is then withdrawn and a fresh cut started on the next line until it reaches the same distance as the first cut. This operation is repeated until all the cuts have reached this length when the first cut is continued another stage and so on until all the cuts are near the end of the log, when the flitches or planks should be sawn completely through. It is a mistake to endeavour to turn the log end for end, start at the other end and to try to make the cuts meet in the middle. From time to time the front transverse bearer is moved backwards or forwards to ensure that the saw has full play and that the log is being supported to the best advantage.

The log shown in Figs. 3 and 4 was squared on two sides and then turned with one square face down as shown in Fig. 5. The log was then marked with the charcoal line to give 2 inch widths and sawing proceeded as with the original log.

In sawing logs which are destined to give, say, inch thick material for furniture, or eucalypt logs which are inclined to warp, it will be found best to saw to required depth only in the first instance and not to edge the planks until

they have seasoned. Where the completed article is required to have exact dimensions allowance should be made for shrinkage and final planing.

SEASONING.

It is well in all cases to stack the sawn material for seasoning. The pile may be in an open shed or under outside shade well exposed to the air. The pile should be raised on suitable foundations at least a foot above ground level. "Stickers" of squared material ¾ in. to 1½in. should be placed at regular intervals of about 18 inches, *vide* Fig. 8. Heavy logs or stones should be placed on top of the stack to give weight, and the top should be covered with any material which will keep off the rain and sun.

Material such as 3in. x 2in., 4½in. x 1½in., etc., is best cross-piled, i.e., one layer is placed on the foundations with the planks 18in. apart, and the next layer placed on top at right angles with the same 18in. intervals, and so on. No "stickers" are used.

Notes on Cementing Corrugated Iron Tanks.

By Major A. L. COOPER, D.S.O.

In view of the present high price of corrugated iron, to say nothing about the difficulty of procuring it, the following notes are likely to be of interest.

I have a circular 2,000 gall. tank, which in normal times I should have scrapped, as it would not hold small coal, let alone water. The cost of a new one now would be in the neighbourhood of £30, and as I had seen smaller tanks in the Union (where the life of galvanised iron is very short all along the coast), covered over with cement, I decided to experiment on this 2,000 gall. tank. The result is eminently satisfactory.

The first thing to do is to build a solid foundation, as any distortion due to settling means a crack in the tank. A 14in. brick circular foundation, filled in with well damped rubble and earth, covered with 3in. of concrete 5:3:1. The diameter of the top should be 12ins. greater than that of the tank.

Now to prepare the tank: First cover the whole side of the tank with old chicken netting- 1in. mesh is the best, but if only 2in. is available, put on two layers. It does not matter how old or torn it is. Suitable netting can usually be procured on the Market Square any Saturday morning, for a few shillings. Care must be taken that the netting must be evenly stretched over the tank, leaving no blank spaces, otherwise there is difficulty in making the plaster adhere.

When your chicken wire is satisfactorily stretched, the whole must be bound together with No. [illegible] fencing wire. About 100 yards will be needed. This acts as reinforcing.

Fasten one end of the wire to the top socket of the tank, in which a 4in. nipple and another socket have already been

inserted, to keep the top clear of the plaster, and then wind your wire carefully round and round the tank, spacing each from about 9in. above the last. Fasten the end of the wire when you reach the top.

Your tank is now ready to place in position.

Cover your concrete foundation with plaster (2 clear river sand, 1 cement), an inch thick evenly all over. Get at least five natives to lift the tank off the ground, and place *in situ* on the cement plaster while it is still wet. See that the tank is centrally placed on the foundation. Now proceed to cover the tank with the same plaster (2 sand, 1 cement). It does not matter how rough it is so long as the whole tank is covered. Allow this to set for 24 hours.

The next day put on your final coat of plaster· This should consist of river sand sifted through mosquito netting, mixed with cement in the proportion of 5 to 2. It should be carefully smoothed over with a plasterer's trowel, and rounded off with a bobble where the tank meets the foundation. See that the plaster is well worked into all interstices.

While your final plaster is setting, open out sufficient old sacks to cover the sides of the tank, and stitch them roughly together so that they make a screen with which you can drape the tank all around as soon as the plaster is set. Keep this screen saturated for at least 48 hours longer, if possible.

The tank can now be filled, and bar accidents, should last forever.

Approximate cost:—

The old tank		Nil	
8 Pockets cement	£1	16	0
2 cubic yards sand	0	15	0
Chicken netting	0	5	0
10 S.W.H. Wire 100 yards	0	5	0
Bricks and sundries, say......	0	10	0
	£3	11	0

Plan ahead to meet Poultry Feeding Problems.

By H. G. WHEELDON,
Chief Poultry Officer.

As in other countries the feeding of poultry in this Colony is becoming affected more and more by international circumstances. Although the general position with regard to supplies of stock foods may present difficulties it is evident that the general farmer would be favourably placed to continue his poultry enterprise by relying to a greater extent on such farm grown foodstuffs as it may be possible for him to produce.

The increased demand for certain food constituents, the limited supplies of our local production and problems connected with importations to eke out supplies, have all contributed recently to inadequate supplies especially of wheaten products such as bran and pollard.

Assuming that supplies of certain concentrates may continue to fluctuate to some extent for the duration, the necessity for farmers to be prepared in such emergency by the production of poultry foods for substitution of the usual rations becomes obvious. The alternative of relying entirely upon bought constituents for substitution seems uncertain in view of the tendency to stimulate the demand for available foodstuffs to such an extent that the demand may exceed the supply. It means planning in advance as a war time measure and individual action with the object of growing more to meet individual requirements.

If the difficulties which lie before us can be overcome by the greater use of farm grown foodstuffs, it is evident that laying flocks, under such circumstances, can only be maintained by giving this matter attention well in advance, and whether timely consideration in this respect may achieve anything must depend upon individual effort.

The following rations substituting bran and pollard, have been compiled of a variety of constituents, some of which may be home grown and from which a selection can be made to meet the circumstances and requirements of producers in various parts of the Colony.

(a) Laying Hens.

	1.	2.	3.	4.	5.
	lbs.	lbs.	lbs.	lbs.	lbs.
Maize Meal	50	55	55	55	45
Ground Oats	—	—	—	10	—
Lucerne or Sunflower Leaf Meal	15	15	15	10	15
Meat Meal	15	15	15	10	10
Monkeynut Cake Meal	10	—	5	15	10
Wheat Screenings	—	15	—	—	—
Barley Meal	—	—	—	—	15
Maize Germ Meal	—	—	10	—	—
Kaffir Bean or Cowpea Meal	—	—	—	—	5
Bone Meal	—	—	2	—	—
Lime	3	3	3	3	3
Salt	1	1	1	1	1

Lime and salt should be added to these rations unless a mineral mixture is incorporated.

Succulent green food should be supplied if possible.

GRAIN.—With any of the above mashes give crushed maize alone or the usual grain mixture.

(b) Laying Hens.

On farms where inexpensive forms of animal protein are available such as skimmed milk or dried blood, the following rations might be of interest.

1. *Milk and Maize Ration.*—A regular supply of separated milk throughout the year is absolutely essential in the case of this ration. Supply daily, thick separated milk *ad lib.* at the rate of four to five gallons per 100 birds. Feed

crushed maize as a scratch grain 1¾ ozs. to 2 ozs. per bird per diem, preferably ⅓ of the daily ration during the morning and ⅔ during the afternoon. Also succulent green food supplied daily in sufficient quantity is necessary for success with this ration.

2. *Dried Blood Meal.*—Ox blood from the slaughter house is mixed with wheat bran or mealie bran as follows:—

The fresh blood is poured on to heaps of bran and thoroughly mixed by the use of shovels, the proportion being 1 blood to 3 bran by weight. This mixture is exposed to the sun and bagged when thoroughly dry for use as required.

MASH.—Maize meal 20 lbs.; bran with blood 40 lbs.; Lucerne leaf meal 10 lbs.; maize germ meal 15 lbs.; wheat screenings 15 lbs.; bone meal 2 lbs.; lime 3 lbs.; salt 1 lb. Supply grain at the rate of 1½ to 1¾ ozs. per bird.

(*c*) *Rearing Chickens.*—For rearing chickens on rations without bran, pollard or milk.

1. Select any of the foregoing mashes for adult stock, increase the quantity of maize meal by 20 lbs. for the first 12 weeks after hatching, thereafter by 30 lbs. until laying maturity is reached. Adjust mineral salts to Bone meal 1 lb., lime 2 lbs., salt ½ lb. A small quantity of munga could be supplied daily with advantage during their early life as a scratch grain. At eight weeks give crushed maize and munga as a grain mixture.

2. Where a liberal supply of milk is available for rearing chickens give the following mash with thick separated milk *ad lib.* Maize meal, 85 lbs.; Lucerne leaf meal, 10 lbs.; meat meal, 5 lbs.; bone meal, 1 lb.; lime, 2 lbs.; fine salt, ½ lb. If the supply of milk becomes limited increase the meat meal to 10 per cent., or if monkey nut cake is available it can be used as a substitute up to about ⅓ of the meat meal, i.e., about 6½ per cent. meat meal, and 3½ per cent. nut cake. It would be false economy to reduce this quantity of meat meal for chickens.

3. The following ration without milk has proved satisfactory during the period which it has been tested: Maize meal 65 lbs.; Lucerne leaf meal, 15 lbs.; meat meal, 15 lbs.;

monkeynut cake meal, 5 lbs.; bone meal, 1 lb.; lime, 2 lbs.; salt, ½ lb. No grain is fed with these chick rations except a little munga may be given as a scratch grain.

(*d*) *Ducks*.

1. Select any of the laying flock mashes. For adult stock and ducklings retained as breeders from 8 weeks of age, reduce the quantity of maize meal 10 per cent. and increase the amount of leaf meal by 10 per cent.

2. For ducklings intended for the market as table birds continue to feed the mash selected without alteration. Feed a crumbly moist mash four or five times a day for the first four weeks then three times a day until marketed at 10 to 12 weeks of age. A reduction in the cost of the rations for ducks of all ages could be effected by the addition of boiled pumpkins when these are available, to the extent of 20 per cent. for ducklings and 40 per cent. for adult ducks.

GENERAL.

It is hoped the suggested formulas will be regarded as emergency rations, some of which have not yet been tested but they can be confidently recommended for judicious use. From close observation adjustments should be made to the best advantage by regulating the quantity of grain feed in order to meet the requirements of the stock and maintain satisfactory egg production.

These rations have been selected as far as is possible with a view to economy, embodying constituents which can be produced or substituted on farms or procured on the market. For example sunflower leaves gathered at the right stage of growth, carefully dried in the shade and milled or crushed as a substitute for lucerne leaf meal offer wide scope for home production. The quantity of leaf meal may be made up by substituting ⅓ the quantity with sunflower head meal; also maize bran, a good sample of bean hay meal and other fibrous by-products which might be available to individual producers are suggested in reasonable quantity to furnish the necessary bulk to the mashes. Leguminous leaf meals including sunflower leaf meal should be given preference where possible. They furnish not only bulk, but protein, mineral matter and a substitute for green food. Meat meal and monkeynut cake

meal are to some extent interchangeable according to circumstances, but they are difficult to replace adequately without skimmed milk, butter milk or fish meal. If protein foods of animal origin are not available, vegetable proteins such as monkeynut cake meal, soya bean meal, kaffir beans or cowpeas are the best alternatives. Hominy chop where available can be used to replace up to 50 per cent. of the maize meal.

Alternatives to crushed maize as a grain food are munga, kaffir corn, barley, buckwheat and sunflower seed mixed together or given separately, but either buckwheat and sunflower seed should not exceed one-fifth of the total grain ration.

SOUTHERN RHODESIA OFFICIAL EGG-LAYING TEST, 1942-1943.

The next Test will commence March 1st, 1942. Entries close 21st January. Full particulars, rules and entry forms can be obtained on application to the Poultry Officer, Department of Agriculture, Salisbury.

Single pen accommodation is provided. Intending competitors are advised to make early application.

Diseases of Fruit, Flowers and Vegetables in Southern Rhodesia

5.—DISEASES OF POTATOES.

By J. C. F. HOPKINS, D.SC. (LOND.), A.I.C.T.A.,
Senior Plant Pathologist.

No account of diseases of potatoes in Southern Rhodesia has been published since the note which appeared in this journal in August, 1931. (1) Since that date, considerably more information has been obtained on the common diseases which occur in the Colony, and in view of the importance of potatoes as a crop during wartime, it is thought advisable to publish as much as is known to-day. The main troubles which affect potatoes may be divided into three classes, namely, diseases of the leaf and haulms, tuber diseases and virus diseases; the latter being the main cause of "running out" of seed.

EARLY BLIGHT.

(*Alternaria solani* (Ell. & Mart.) Jones & Grout)

Description.—The first signs of the disease are small, dark brown, somewhat angular spots which appear on the bottom leaves of the plant approximately when the first flower buds begin to show. The spots increase in size, usually becoming circular in shape, and develop slightly raised, concentric rings in the discoloured tissue. As the disease advances, the bottom leaves turn yellow and further small brown spots appear on the upper, green leaves. The spots increase in number, the leaves begin to shrivel and the whole of the plant becomes involved. The bottom leaves soon die and do not remain attached to the plant (as with the virus disease, leaf-drop streak), leaving a bare stalk with a small bunch of

green leaves at the top. The stalks finally collapse and lie on the ground, the condition being mistaken by most growers for normal maturation.

The fungus may also invade the tubers and cause small sunken spots extending about an eighth of an inch into the flesh, which becomes corky and may be removed with the tip of a penknife. It does not cause an extensive rot, but predisposes affected tubers to rotting by secondary organisms, and is probably a source of primary infection for the succeeding crop.

Contributory Conditions.—Early blight is general on the rain grown crop, but is not of any significance on the irrigated crop, because high atmospheric humidity and relatively high temperatures are necessary for the disease to develop epidemic proportions. Potatoes planted with the first rains in November usually reach an advanced stage of growth before the disease puts any check on plant development, so that the damage caused is not as a rule great. The case is different, however, with January planted potatoes, which are not very far advanced when the rains are at their height. It is usual for the crop at this time of year to be killed down soon after flowering. The destruction of the foliage at the maximum period of growth has a very detrimental effect upon yield, which, in many cases may be reduced to little more than half of normal.

Control.—Early blight may be controlled by spraying with copper fungicides, but it is necessary that the spray be applied early in order that the lower leaves are protected before the top foliage becomes dense. Maximum efficiency in spraying can only be obtained by the use of high pressure pumps which eject a penetrating spray, but, as few of these are possessed by growers in Rhodesia, the protection of the lower leaves early in the season is of great importance. Knapsack pumps have been shown to be quite effective provided 3 or 4 successive applications are given at intervals of 10 days to a fortnight, depending on the rate of growth of the crop. Bordeaux mixture has been the principal fungicide employed in the past, but satisfactory control of the disease has been obtained by the use of colloidal copper and red copper oxide. Proprietary sprays containing these substances are now marketed in Rhodesia.

BLACK SCURF.

(*Corticium solani* Bourd & Galz.)

Description.—Black scurf, sometimes known as *Rhizoctonia*, is of very common occurrence in Rhodesia. It is mainly recognised by its symptoms on the skin of the tuber. Under certain conditions, however, it does attack the stalks causing stem canker and death of the plant. The stem canker stage can usually first be detected by the appearance of stunted or wilted plants in the field. If these are examined, soft brown lesions will be found on the bases of the stalks, which in some cases may be completely encircled by diseased tissue. When the attack is severe the plants often adopt a bushy type of growth and may produce aerial tubers on the stems. (Fig. 1*t*.) In addition, the foliage may be light green in colour and eventually show signs of wilting. When conditions favour the disease, the young sprouts may be killed before they reach the surface of the ground, in which case a very poor stand is obtained, whilst larger plants show a greyish-white powdery coating on the bases of the stalks. (Fig. 1*c*.) This is the perfect form of the fungus, which does not often develop under Rhodesian conditions.

The most common and distinctive symptom of the disease is the occurrence of small irregular lumps, resembling pieces of dry soil, on the skin of the tuber. If they are moistened and rubbed with the finger they will be found to consist of black carbonaceous tissue which does not wash off. (Fig. 2.) These are the sclerotia, or resting bodies, of the fungus and are responsible for carrying over the disease from year to year. When the tubers are planted in moist soil, the black sclerotia send out filaments which attack the growing parts of the potato plant causing the symptoms just described.

Contributory Conditions.—The fungus, *Corticium solani*, is a normal inhabitant of most Rhodesian soils, but does not attack potatoes unless conditions are suitable. Low temperatures and wet, poorly drained soils coupled with heavy rain are ideal for the development of black scurf, so that the disease is usually more prevalent on heavy clay soils than on the lighter sandy loams.

Control.—Although the fungus normally inhabits the soil, it does not seriously affect potatoes grown from clean

seed under good cultural conditions. If, however, as is not infrequently the case, the seed to which sclerotia are attached is planted, then serious damage may be caused by the fungus if a period of cold wet weather is experienced. Treatment of the soil offers no possibilities of control, but disinfection of seed tubers is recognised as being highly effective. Mercury preparations are usually used as a disinfectant bath, and proprietary dips are marketed in Southern Africa. Acid corrosive sublimate may also be used. This is made up as follows:—

Dissolve 4 ozs. of corrosive sublimate powder in 2 pints, of commercial hydrochloric acid (spirits of salt) and dilute to 25 gallons with water. This solution corrodes metal, so that if iron drums are used for dipping, they must be painted inside with a protective covering such as tar.

The procedure is to treat a bushel or so of tubers at a time, for which the following equipment is required—

2 iron drums treated inside with a bitumen compound;

a basket or bag to fit into the drums; and

a hoisting tackle to lift the potatoes in and out of the drums.

The latter can be made quite simply by erecting a counterbalanced, pivoted gum pole on a support with a swivel at the top, allowing of vertical and lateral movement. The potatoes, from which superficial dirt has been removed, are placed in the basket, lifted into the first drum of clean water and agitated until all the tubers are wetted. The basket is then withdrawn and allowed to drain for a few seconds. It is then immersed in the second drum containing the acid corrosive sublimate and allowed to soak for 5 minutes. It is withdrawn and allowed to drain again. The potatoes are then removed and dried thoroughly in a shady place or planted immediately. The best control is obtained if potatoes are treated as soon as they are lifted, but, in any case, the treatment must take place before they have begun to sprout. The corrosive sublimate dip gradually loses its strength and should be renewed from time to time. Twenty-five gallons of solution are sufficient to treat 40 bushels of seed.

Great care should be taken in the disposal of discarded dip as it is extremely poisonous to animals and human beings. It should not be allowed to stand in puddles, but should soak into the ground. All vessels used for dipping should be thoroughly cleaned out with hot water and washing soda before being stored away and corrosive sublimate crystals or powder should be kept out of reach of children and natives. The hands should be thoroughly washed before a meal is taken and it is inadvisable to smoke cigarettes while dipping is proceeding, owing to the danger of the paper becoming contaminated with the poison and reaching the mouth.

SUN SCORCH or TIPBURN.

Description.—An affection of the foliage, which has been mistaken for Irish or late blight, develops during hot dry weather. It is sometimes common in irrigated crops during October. Affected plants show a tendency to wilt due to some of the leaves becoming flaccid, and drooping slightly. Close examination shows these leaves to possess a yellow coloration at the tips, which later become necrotic. The dead areas are V-shaped and extend into the leaflets, producing dark brown blotches which may eventually cause the collapse of the entire leaf. All of the foliage is not necessarily involved, but effected plants are prominent in the lands. The trouble due to sunscald is accentuated if the weather is so hot and dry that weekly irrigations are necessary. The disease is evidently the same as that known elsewhere as tipburn and is not infectious.

HOPPERBURN.

The disease known as hopperburn also occurs in Rhodesia, although it has not been closely investigated.

Description.—The leaves of affected plants show yellowing at the tip, followed by a V-shaped dead area similar to tipburn. The yellowing extends along the margins of the leaflets causing them to curl upwards. The midrib area remains green for some time, but that eventually turns yellow and the whole leaf withers.

When the plants are examined closely, small green insects, known as leafhoppers, may be seen in abundance. They

dart about from leaf to leaf as the foliage is disturbed. It is thought that these insects inject some toxic substance into the leaf tissues whilst they are feeding and that this substance causes the disease.

Contributory Conditions.—Hopperburn seldom occurs on young plants and is rarely seen before flowering. It is most prevalent in hot dry weather, which seems to favour the rapid increase in the number of insects. Weak plants and those seriously affected by virus diseases may collapse prematurely, with consequent serious reduction in yield. Shortage of water may also favour the development of hopperburn.

Control.—Spraying with Bordeaux mixture has proved effective against hopperburn in America. (2)

MILDEW.

(*Oidium sp.*)

Powdery mildew, similar to that commonly known as white mould on tobacco, has been recorded from the foliage of experimental plants growing under glass. It has not been reported from field crops.

BLACKLEG.

(*Bacillus phytophthorus* Appel)

Description.—Affected plants show an upright habit of growth, the leaves being somewhat compacted and yellowish in colour. If the plant is attacked early it may be dwarfed, or the seed-piece may rot away before the plant emerges above soil, thus producing a poor stand. The stems of infected plants show a black discoloration, which extends from soil level downwards into the crown and roots, and the pith is usually disintegrated. In well grown plants, the rot usually extends along the side "roots" (stolons) into the tubers, causing a brown discoloration of the vascular ring and rotting of the flesh. The diseased area is whitish and of a cheesy texture, not watery, and may extend from the vascular ring outwards to the skin or the whole of the pith may be rotted away, leaving a large cavity. In most advanced cases, the flesh of the tuber eventually turns to a black, slimy pulp.

Contributory Conditions.—Ill-drained soils and wet conditions generally are favourable to the development of blackleg, which is not as a rule serious on potato land in good heart. The disease is usually contracted through infected seed, but the stem and tubers may pick up infection from the soil through the lenticels or pores, when soil conditions are such that the pores are induced to open wide. Small, discoloured and sunken spots round the pores may be seen in the new tubers of infected plants growing in waterlogged patches of land.

The disease may be spread in stored seed by contact or by means of insects, so that poor storage conditions and lack of supervision are followed by a serious outbreak of blackleg in the next planting.

Control.—As soil infection is usually confined to waterlogged or inefficiently drained patches, attention should be given to correcting the faults either by improving the slope of the land or treating the soil so as to bring it into a porous condition. It is a well established fact that infection is carried over in seed tubers, so that frequent culling of any obviously rotted tubers should be undertaken. The seed should be inspected at least once a fortnight.

In America it is known that the seed-corn maggot, lava of the fly *Hylemyia cilicura*, plays an important part in spreading blackleg from infected to healthy seed-pieces during storage and after planting. This fly occurs in Southern Rhodesia but its relationship to the spread of blackleg has not yet been investigated. Observations of seed in storage have shown that several species of flies are associated with rotting tubers and they are known to breed in the decayed flesh. It appears very likely, therefore, that flies may spread a considerable amount of disease from rotted to healthy tubers in storage.

Blackleg may also be distributed through seed during the cutting process, and this is an added reason why careful culling of all unsound seed should be carried out at short intervals.

WILTS.

(*Verticillium albo-atrum* Reinke & Berty)
(*Fusarium oxysporum* Schlecht.)
(*Fusarium solani* App. & Woll.)
(*Fusarium coeruleum* (Lib.) Sacc.)

Description.—Odd plants scattered through the land, or patches of plants in small areas may occasionally commence to wilt, turn yellow and collapse prematurely. The stems of such plants show a brown discolouration of the woody tissues which may extend for 8 to 10 inches above soil level. There is no discoloration of the outside of the stem, thus contrasting with the symptoms of typical blackleg. The disease is caused by several soil inhabiting fungi, alone or in combination with other soil organisms, which invade the young roots, growing along the water conducting vessels, choking them up and preventing the flow of sap. Thus the tops of the plants, being unable to obtain water to replace that which evaporates from the leaves, wilt and eventually die.

At least one of the wilt-producing fungi (*Fusarium coeruleum*) is carried over in seed tubers, in which it may be detected by the presence of a firm sunken patch at the stem-end. (Fig. 3). When the tuber is cut lengthwise, a portion of the flesh at the stem-end will be found to be affected by a brown, corky rot (stem-end rot) and when cut across below the rotted portion, a brown ring will be seen in the otherwise healthy flesh.

Contributory Conditions.—Little exact information on the contributory conditions has been obtained in Rhodesia. Wilts occur most commonly on infertile soils and during periods of hot, dry weather.

The fungi causing potato wilt normally live in the soil and occur in land in which potatoes may never have been grown. Some types of soil are more prone to wilt than others, but it is cultural conditions that usually govern the amount of disease which develops. Dry soils, which pack hard give a high percentage of wilt, as also do light, infertile sands. Certain kinds of soil, which are common on the eastern border, are also bad for wilt. They have a very high nitrogen

analysis, but the nitrogen is present in the form of partly decomposed plant debris and is therefore not wholly available for plant nutrition. It is found that potatoes grow well for five to six weeks in these soils, and then some plants commence to wilt. The number of diseased hills increases until the whole crop may die down. It is thought that the plants grow normally until all available nitrogen is exhausted and that the wilt fungi then invade the roots, which have by this time lost their power of resistance.

Control.—The control of wilt largely depends on the correct choice and preparation of potato lands. Liberal applications of compost or manure have been shown to eliminate wilt, whilst artificial fertilisers must be added according to soil requirements. Soil which packs hard and very light sandy loams deficient in humus should be avoided. Soils in which the nitrogenous matter is insufficiently decomposed should not be planted to potatoes until they have been well worked to other crops or, alternatively, have been treated in a suitable manner with compost, artificials or lime.

Crop rotation is of little use on unsuitable soils and potatoes should not be planted on lands where serious losses from wilt have been experienced.

As the disease is transmitted in seed, only healthy tubers should be used for planting. All tubers showing a depression at the stem-end should be culled before planting time and any seed showing a discoloration of the vascular ring on cutting must be thrown out.

STEM AND ROOT ROT.

(*Sclerotium rolfsii* Sacc.)

Description and Contributory Conditions.—This disease is uncommon in Rhodesia, but may cause total loss of plants in areas of land which are poorly drained. Stem rot, due to *Sclerotium rolfsii*, may be distinguished from similar kinds of disease by the presence of coarse, white bands of fungal tissue on the bases of the stems and on the tubers, and the absence of odour in the rotted portions of the plant. In the early stages, tubers may show only a small white rotted area, but as the fungus advances, the rot becomes yellow and under

very wet conditions the tuber tissues become watery. Soon after the appearance of the fungal mycelium on the stem bases, small spherical sclerotia are produced, which are at first white and then turn pale brown in colour, resembling mustard seeds. The presence of the sclerotia is sufficient for diagnosis of the disease.

Control.—*Sclerotium rolfsii* is a common root parasite on a wide range of plants and is probably present in all tropical soils. Its growth is controlled by soil temperature and humidity, so that prevention of stem and root rot depends on the maintenance of cultural conditions inimical to the fungus. Good drainage is the principal condition to be observed, especially in the hotter areas of the Colony, as high temperatures favour the parasite.

Infected seed tubers should be removed whilst in storage in the same way as for other tuber-borne diseases.

BLACK DOT.

(*Colletotrichum atramentarium* (Berk. & Br.) Taub.)

This disease is rarely encountered in Southern Rhodesia. It causes affected plants to wilt and may be distinguished from other wilts by the presence of very small, black bodies on the bases of the stems, which give the name black dot to the disease. So far it has only been found in association with *Fusarium* stem-end rot and does not appear to be of economic significance in the Colony.

COMMON SCAB.

(*Actinomyces scabies* (Thax.) (Güssow).

Description.—Scab is well known to potato growers, although it is sometimes confused with advanced stages of eelworm (*Heterodera marioni*) infestation. Only tubers are affected. The symptoms vary a good deal according to some writers, but in Rhodesia the general appearance of infected tubers is that shown in Fig. 4. The casual fungus, *Actinomyces scabies*, penetrates the thin skin of young developing tubers, causing a small, rough, corky spot to form. As the tuber develops, the corky areas enlarge to various sizes and, in extreme cases, may cover almost the entire surface. Sometimes relatively deep pits may develop in the

scabby spots, but it has not been ascertained in Rhodesia whether they are due entirely to fungus attack.

The flesh of diseased tubers is little or not at all affected, but the presence of the rough, corky lesions on the skin disfigures the potatoes, lowering their market value and very often brings about considerable waste in their preparation for table use.

Contributory Conditions.—Scab is associated with soils which are alkaline or deficient in humus. It becomes most virulent in soils which are planted to potatoes immediately after the application of lime. Moderately high soil acidity checks the growth of the fungus and scab does not occur when such conditions exist.

Control.—Seed treatment was at one time employed for the control of scab, but is no longer recommended. Attention should be directed to the careful selection of potato lands, eliminating those of neutral or alkaline reaction, and to the treatment of soils so as to render them acid. A pH of 5.6 will ensure complete elimination of scab, but satisfactory crops may be produced on less acid soils if green manures and acidifying fertilisers are applied.

Affected seed should not be used.

POWDERY SCAB.

(*Spongospora subterranea* (Walls.) Johnson)

Description and Contributory Conditions.—This is another disease which is not of economic significance in Southern Rhodesia, although it is generally distributed in other parts of the world. It first appears on young tubers as small raised blisters, the skin covering of which ruptures as the tubers mature, curling back to form small, ragged-edged craters. It is similar in appearance to advanced eelworm damage.

Powdery scab is usually present on seed potatoes imported from temperate parts of the world and at one time gave rise to alarm on the part of Rhodesian seed producers. Tests carried out at the Plant Pathology laboratory, however, showed that under the climatic conditions of Salisbury, infected tubers invariably gave rise to a clean crop. The disease

does not develop unless soil temperatures are below 60 deg. F. and the moisture content is very high, so that there should be no danger of it appearing in the main potato producing areas.

If infected seed is to be planted in the cooler and wetter parts of the Colony, seed treatment would be advisable. It is doubtful if the casual fungus occurs naturally in Rhodesian soils.

BROWN FLECK or SPRAING.

Description.—This disease is well known to potato growers and housewives alike. It is characterised by the presence of brown regions of dead tissues scattered through the flesh of the tuber. The flecks vary very much in size from that of a pin's head to half an inch or so in diameter. They may be situated in the centre or towards the outside and apparently bear no relationship to the vascular ring, but occasionally exhibit a radial arrangement. The disease cannot be detected except by cutting the tuber, so that affected crops are often sold as sound potatoes, resulting in complaints being received from consumers. When flecked potatoes are cooked, the brown spots remain hard and turn black in colour.

Contributory Conditions.—The disease has been ascribed to many causes, including parasitism by fungi, bacteria and viruses, and there is no doubt that it has been confused with various types of internal browning of different origin. No full investigations have been made in Rhodesia, but in the Union (3) the disease is attributed to phosphorus deficiency in acid soils. Brown fleck is usually associated with infertile soils in Rhodesia.

Control.—As adverse soil conditions appear to be the primary cause of the disease, lands in which badly affected crops are consistently produced should be taken out of potato cultivation. Where the disease is slight, it is recommended in the Union (3) that lime and superphosphates should be applied as a corrective. The lime, of course, should be applied as long as possible before the crop is planted in order to avoid scab, and superphosphate should be used in preference to basic slag or rock phosphate, owing to its ready availability to a crop whose phosphorus requirement is high.

INTERNAL BROWNING.

Other forms of internal browning occur in tubers. They are caused by various agencies, but the most common troubles are drought spot and what is known as net necrosis. The former, as the name implies, is brought about when the crop is subjected to a shortage of water, which sometimes occurs during exceptionally hot periods either before general rains set in or in dry periods during the rainy season. This spotting is fairly common if drought occurs in January or February. The browning appears first in the vascular ring and in the tissues round about it, mostly on the outside. If the tuber is cut, the discoloration will be seen to be in strands, not in spots, thus differing from brown fleck.

Net necrosis may be seen, when the tuber is cut, as a network of fine brown lines throughout the flesh; in mild cases the net pattern may be confined to the stem-end. The necrosis is often caused by the virus of leaf-roll, so that affected tubers should not be used for seed and should be discarded if detected whilst being cut for planting.

BLACK HEART.

This is a physiological disease and is not infectious. It results from the breakdown of the central fleshy tissues, due to high storage temperatures, inadequate ventilation or a combination of both factors. The disease may develop in potatoes left in the land during the dry season if there is an insufficient depth of soil to insulate them from the heat of the sun, which increases from August onwards. Similar conditions may be brought about by unseasonal rains, which, by wetting the soil and reducing its insulating power, allow too much heat to penetrate to the level of the tubers. Black heart may also develop in tubers which are exposed to the hot sun after digging.

Affected potatoes are difficult to detect by external examination, but, when cut into, show a dark brown, grey or black discoloration of the heart (Fig. 5). The flesh is firm, unless invaded by secondary organisms, the entrance of which is facilitated by the disease. Proneness to rotting makes them unsuitable as seed for dry planting.

Seed should be stored in single, or, at the most two layers in depth and particular attention should be given to ventilation in the hotter parts of the Colony.

HOLLOW HEART.

This condition is not uncommon in Rhodesia and is caused by excessively fast or irregular growth of the tubers. It may be produced by forcing the crop too much with fertilisers during very favourable growing periods. It is more likely to occur in large than in small tubers, but it can develop in the latter. The condition affects the marketability of the potatoes but, as far as is known, they are not unsuitable for seed.

The symptoms are well known to most growers. Affected tubers have irregular cavities of varying size in the centre and there may be no discoloration or the cavity may be lined with a brown, glassy skin.

Control depends on regulating the growth of the crop by suitable methods of fertilising and irrigating.

WHITE SKIN SPOT.

Sometimes, especially in the irrigated crops, a large proportion of tubers may show small, raised, white pustules about as large as a pin's head. These are sometimes mistaken for eelworm galls or scab. Actually, they consist of extrusions of the internal flesh through the pores in the skin of the potato, the condition being brought about by excessive soil moisture. In Rhodesia, white skin spot seems to have no deleterious effect upon tubers.

SPINDLE SPROUT.

It is well known that a certain proportion of seed tubers may produce thin and weak sprouts. They may result from a variety of causes, including virus degeneration. Tubers from leafroll plants may produce a good deal of spindle sprout. The condition may also be brought about by rubbing off the large sprouts too many times, when rains arrive late, in an endeavour to preserve the seed in suitable condition for planting.

Spindle sprout tubers should be discarded for seed purposes.

ABNORMAL TUBERS.

Deep cracks, knobbiness and pointed ends are usually to be found in potatoes and they often are due to unfavourable growing conditions; but sometimes they may be signs of degeneration due to certain virus diseases.

Knobbiness is frequently encountered in volunteer crops and the presence of a high proportion of such tubers, which are unsuitable for marketing, is one argument against the practice of cropping a land to volunteer potatoes.

Pointed ends can be caused by a check in growth due to drought, but it may also be an indication of the presence of the spindle tuber virus, which may cause very rapid degeneration of seed. Deep cracks may also point to advanced degeneration.

STORAGE ROTS.

One of the most common forms of storage rot is that caused by the fungus *Fusarium oxysporum* f.1. Affected tubers show small, sunken areas, which enlarge until the whole of the tuber may be involved. The rot is firm and the flesh is converted to a brown spongy mass of cork. In advanced stages of the rot, small white tufts of the fungus grow out through the skin of the potato giving the tuber a characteristic appearance. (Fig. 6.)

The full range of tuber rotting organisms has not been worked out in Rhodesia, but there are a considerable number causing both wet and dry rots. They do not normally invade sound tubers, so that every care should be taken to prevent damage; especially should care be taken to see that potatoes are not left exposed to the sun after lifting. Sun scald on thin skinned, immature tubers is probably an important reason for the poor keeping qualities of irrigated potatoes, and it is well known that if seed is lifted in hot weather, a large amount is likely to break down before it is planted.

DEGENERATION DISEASES

All potato growers are aware that seed loses its vigour or "runs out" after a few successive crops have been grown from the same stock. Freshly imported and "first-from-imported" seed can be guaranteed to give good returns; "second-from-imported" may give high yields under favour-

able circumstances; but the yield from then onwards drops, until "fourth-from-imported" is unlikely to give an economic return.

This progressive degeneration is still thought by some to be due to continued vegetative propagation which induces a kind of senility, but such is not the case. The real cause of degeneration is the presence of infectious viruses which, starting from a few contaminated tubers, spread rapidly through the crop with each successive planting. The viruses are contained in the tubers and spread through the whole plant as it grows, so that the sap of the leaves and stems is also infectious. The diseases are distributed from infected to healthy plants either by leaf contact or by means of insects. The green peach aphis, *Myzus persicae*, is reported from most parts of the world as being the principal vector of the potato viruses but other aphids are also involved. Several green aphids, of which *Myzus persicae* is one, occur on potatoes in Southern Rhodesia, and, although no extensive work has been done on the local potato viruses, there is little doubt that aphids are a most important factor in the running out of local seed, by spreading degeneration diseases through the crops.

Of the many virus diseases observed in Southern Rhodesia, only two seem to be of much importance. These are known as leaf roll and leaf-drop streak, the latter more or less predominating in degenerate stocks Mosaic is also fairly common, but does little harm unless combined with another virus, when leaf-drop streak is produced.

LEAF ROLL.

Description.—Healthy plants which become diseased seldom show symptoms in the first year unless infection has taken place very early in the season. Tubers from such plants are, however, diseased and in the subsequent crop produce degenerate plants which are pale in colour, due to the leaflets having their margins rolled in towards the midrib, thus exposing the light coloured undersurfaces. The leaves are thick, tough and brittle and produce a characteristic rattle when shaken, contrasting with the softer and thinner leaves of healthy plants, which do not rattle. Severely affected plants are stunted and have their leaves pointing up-

wards; the tubers are small, few in number and the yield much reduced. Many of the tubers are of seed size and are, unfortunately, often selected for seed; but they are all infected with the leaf-rolling virus and produce only weak and poorly yielding plants.

LEAF-DROP STREAK.

This disease is extremely common in Rhodesia and seems to be the main cause of rapid degeneration of seed in the third and fourth years. It has two sets of symptoms, known as primary and secondary, which are quite distinct and may be seen in most potato fields.

Description.—The first symptom of the disease is the presence of small black spots or streaks on the veins on the undersides of the leaves (Fig. 7). They increase in size as the plant grows and extend down the leaf stalk to the stem. Long brown streaks also appear on the stems and by this time the spotting is visible on the upper surfaces of the leaflets. The leaves are now brittle and if pressed down gently with the forefinger snap off at the junction with the stem, to which they remain attached by a fine thread of epidermis. In the later development of the disease the leaves shrivel, drop and remain attached to the stem, which is crowned by a small bunch of green leaves showing the characteristic brown spots and streaks. (Fig. 8). At this stage the disease is not infrequently mistaken for early blight, to which, of course, it is in no way related. Reports of failure to control early blight by spraying have been traced to this misconception.

Tubers taken from leaf-drop plants give rise the next year to the following "secondary" symptoms.

Plants are stunted and pale, greenish yellow. The stems are thin and tend to lie along the ground instead of growing upwards. The leaves are often bunched and may be rolled after the fashion of leaf-roll, but they are not hard and do not rattle when shaken. (Fig. 9.) The crop is always poor and the tubers small in size. (Fig. 10.) It is because many leaf-drop tubers are chosen that the "running out" of seed is so rapid in the third and fourth year after importing.

Control of Degeneration Diseases.—It is possible to maintain the vigour of potato seed provided the cause of degenera-

tion and the operation of the factors concerned are understood for any given locality.

It has been shown that Up-to-Date potatoes can be grown successfully from the same stock for a good number of years in Rhodesia, provided special precautions are taken. Fig. 11 shows how vigour can be maintained by the elimination of virus infected plants in the land each year, and there are records of "fourteenth-from-imported" crops yielding as well as "first-from-imported," and twenty consecutive crops being raised from originally imported seed (4). Although rogueing in the land before the plants are touching and again at full flower greatly assists in preventing degeneration, it has been found necessary to protect the seed in storage from aphids which feed on the young sprouts; for by this means healthy seed may be infected with viruses.

In addition to the elimination of diseased plants from the lands, it is advisable and, in most cases necessary, to grow potatoes in a locality which is unfavourable to the development of aphids. Moderate temperature, fairly high humidity and a fresh wind tend to keep the insects inactive so that a high elevation, moist atmosphere and somewhat exposed aspect are pre-requisites for the continued maintenance of healthy "stock" seed.

It is most inadvisable constantly to select small tubers for seed, because by so doing there is every likelihood of obtaining a very high proportion of virus infected stock, which can never give a really high yield and in many cases does not bring in an economic return. The low average yield obtained for potatoes in Rhodesia is most probably due to the general use of partly degenerate seed. Tubers weighing less than 1½ oz. should never be planted, unless they are known to come from vigorous stock, relatively free from serious viruses; but no commercial organisation at present exists in Rhodesia for giving such a guarantee for locally grown seed.

WILDINGS AND BOLTERS.

Two other serious causes of degeneration, namely "wildings" and "bolters," which as far as is known, are not due to viruses have not yet been mentioned. These plants are extremely detrimental to commercial stocks and should

be rogued rigorously from seed plots. Wildings are characterised by the production of a large number of thin haulms and numerous small sized tubers, which would to-day be sold as walnut-size seed. Bolters, on the other hand, appear normal until after the crop has flowered, when they can be detected by their later maturity, greater height, robust stems and large clusters of flowers. In crops raised from second-from-imported seed in Rhodesia, as much as ten per cent. of bolters have been seen. The mistake should not be made of selecting these plants for seed under the impression that they are more vigorous and therefore of higher yielding capacity than the remainder: they normally produce one or two large tubers only.

The Department of Agriculture has commenced experimenting with the production and maintenance of "stock" seed at Inyanga. When war broke out, the present shortage of good seed was foreseen and permission obtained from the Imperial Government for the export from Scotland to Rhodesia of two dozen cases of specially high grade (N.I. (A) Certificated) Up-to-Date; all that could be obtained. This seed has been grown for two years, having been rogued twice in the lands and once after lifting each season. In addition, the stored seed has been regularly culled for rotted tubers. Enough seed has now been obtained to plant stock plots at high elevations at Inyanga, Penhalonga and Melsetter, whilst a number of regular seed producers have been supplied with trial samples for testing at lower elevations under the guidance of the Senior Plant Pathologist. An attempt is also being made to establish a seed centre in Matabeleland.

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Fig. 1—Stem, canker stage of black scurf. **t,** aerial tubers; **c,** greyish coating of fungus.

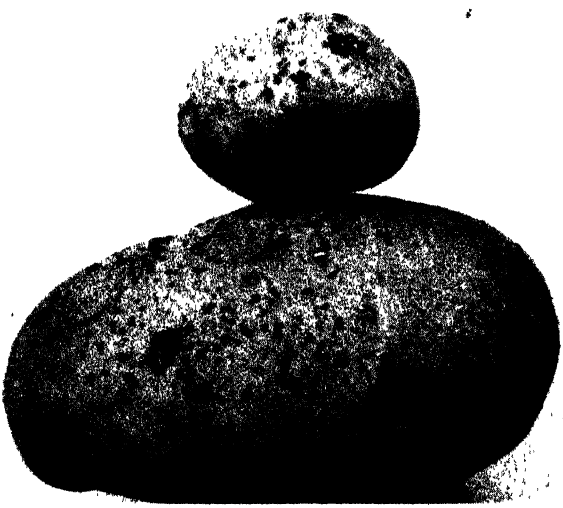

Fig. 2—Sclerotia of black scurf on skin of tubers.

Fig. 6—Common form of storage rot. Note white tufts of fungus.

Fig. 3—Stem-end rot of seed tuber.

Fig 4—Common scab.

Fig. 5—Black heart resulting from exposure to heat of the sun.

Fig. 7—First symptoms of leaf-drop streak. Note dark streaks on veins.

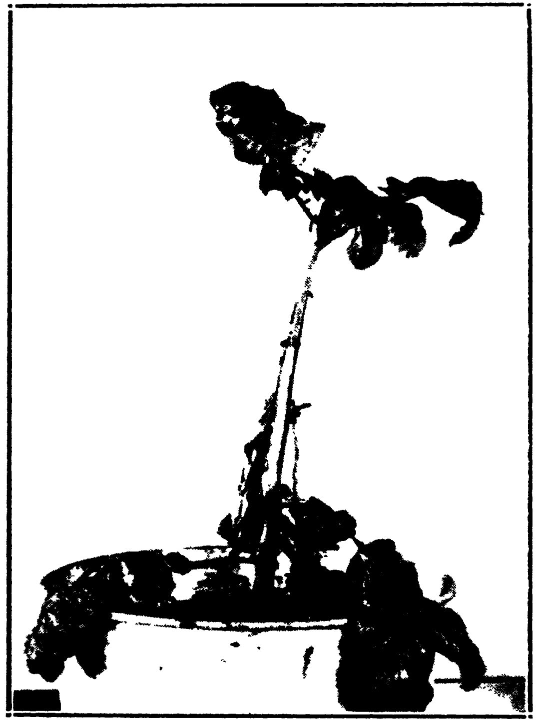

Fig 8—Advanced symptoms of primary leaf-drop streak. This is often mistaken for early blight

Fig. 9—Young plants affected by secondary leaf-drop streak. Note pale colour and flat growth on right and curled leaves on left, resembling leaf roll.

Fig. 10—How degeneration affects yield. Two left hand heaps from healthy plants; right hand heap from leaf drop streak plant.

Fig. 11—Top: Eight-from-imported crop grown at Salisbury Experiment Station from field-selected seed. Bottom: Crop from seed of same origin as above, but not field-selected.

Southern Rhodesia Veterinary Report.

OCTOBER, 1941.

DISEASES.

Anthrax was diagnosed in the Nata Reserve, Plumtree district.

TUBERCULIN TEST.

Twenty-five bulls and twenty-two heifers were tested on importation. There were no reactors.

MALLEIN TEST.

Fourteen horses and thirteen mules were tested with negative results.

IMPORTATIONS.

Union of South Africa.—Bulls, 86; cows, heifers and calves, 25; horses, 14; mules, 13; sheep, 2,191.

Bechuanaland Protectorate.—Slaughter cattle, 54; sheep and goats, 232; pigs, 24.

EXPORTATIONS.

Portuguese East Africa.—Slaughter cattle, 77; pigs, 12; sheep 1.

Northern Rhodesia.—Horses, 8; pigs, 4.

Belgian Congo.—Horses, 2; donkeys, 9.

Union of South Africa.—Donkeys, 10.

EXPORTATIONS—MISCELLANEOUS.

In Cold Storage.

United Kingdom.—Beef quarters (chilled quality), 599; buttocks, 556; rumps, 556; pork carcases, 100; livers, 2,175 lbs.; tails, 1,997 lbs.; fillets, 1,318 lbs.

Northern Rhodesia.—Beef carcases, 268; mutton carcases, 50; pork carcases, 30; veal carcases, 3; offal, 321 lbs.

Belgian Congo.—Beef carcases, 213; pork carcases, 50.

Meat Products from Liebig's Factory, West Nicholson.

Union of South Africa.—Corned beef, 782,928 lbs.; tongues, 2,202 lbs.; Vienna sausages, 6,016 lbs.; steak, kidney and onions, 2,376 lbs.; meat paste, 4,754 lbs.; assorted beef rolls, 2,794 lbs.; Cambridge sausages, 4,008 lbs.; Oxford sausages, 4,584 lbs.; cocktail sausages, 3,660 lbs.; pate de foie gras, 117 lbs.; curried beef, 1,704 lbs.

Northern Rhodesia.—Meat meal, 2,000 lbs.; bone meal, 4,000 lbs.

Kenya.—Corned beef, 3,600 lbs.; tongues, 900 lbs.; Vienna sausages, 1,525 lbs.; ideal quick lunch, 1,200 lbs.; steak, kidney and onions, 120 lbs.; meat paste, 293 lbs.; assorted beef rolls, 2,368 lbs.; Cambridge sausages, 480 lbs.; Oxford sausages, 480 lbs.; cocktail sausages, 750 lbs.; pat de foie gras, 750 lbs.; ham and tongue rolls, 146 lbs.

United Kingdom.—Beef powder, 3,346 lbs.

Belgian Congo.—Meat meal, 6,000 lbs.

B. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-41.

Monthly Report No. 107, October, 1941.

THE RED LOCUST (*Nomadacris Septemfasciata, Serv.*) Only five districts reported locust swarms during October, namely: Melsetter, Chipinga, Bulawayo, Bulalima-Mangwe, and Nyamandhlovu.

The indications are that swarms in the Colony have been working southwards. The Chipinga section of the Melsetter district is a constant haunt of red locust adults in the dry season during a swarm cycle. It appears that two large swarms are present in that region.

Specimens received at Salisbury were of normal migratory colouration and the ovaries were not developed.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA

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